PROFESSIONAL MANUAL

# SMARTMONITOR®

## MODELS 900S, 900SL, 950S, 970S
## Types 1B, 1C, 02

**NOTE:** This manual is not for use with Types 2A, 03, and later SmartMonitors

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# I. USER/OWNER RESPONSIBILITY

This Healthdyne equipment and the authorized accessories are designed to function as described in the operator's manual. **The user(s) of this equipment should not use parts that have failed, exhibit excessive wear, are contaminated, or otherwise ineffective. The monitor and its accessories should not be modified. The following list incorporates the owners' responsibilities:**

1. Periodic check, maintenance, and calibration of equipment;

2. Replacement of components as required for safe and reliable operation;

3. Replacement of ineffective parts with parts supplied by or approved by Healthdyne Technologies;

4. Equipment which is not functioning properly must not be used until all necessary maintenance has been completed and a factory authorized service representative has certified the equipment as ready for use;

5. The monitor and any of its accessories should not be modified;

6. As a general rule, the proper performance of this monitor should be verified with a Healthdyne Model 5000 Simulator according to the Checkout Procedure Manual #925 between each patient use and/or every six to twelve months. Monitors which have been used in a home environment should always be tested between patients.

**The user/owner of this equipment shall have the sole responsibility and liability for any injury to persons or damage to property (including this equipment) resulting from:**

1. Operation not in accordance with supplied operating instructions;

2. Maintenance not in accordance with authorized maintenance/operational instructions;

3. Service by anyone other than a factory-authorized service representative;

4. Modification of the equipment or accessories; or

5. Use of damaged or unauthorized components and accessories.

The user/owner of this equipment is responsible for reading, understanding, and following the Warning and Caution statements throughout this manual, including Chapter XV, on pages 57 - 60.

# II. INTRODUCTION

This manual is intended to provide all the information needed to operate Healthdyne Models 900S, 900SL, 950S, and 970S SmartMonitors. Carefully read and understand this manual before using any of the SmartMonitors mentioned above. **Federal law restricts this device to sale by, or on the order of, a licensed physician. The instrument should be used under the supervision of a physician.**

### How the SmartMonitor Operates

The SmartMonitor is designed to monitor respiration and cardiac activity. To measure respiration, two electrodes are placed on the thoracic cavity and the SmartMonitor passes electronic signals between the electrodes. As the chest moves during respiratory effort, the impedance between the electrodes changes. The electronic signals caused by the changes in impedance are picked up by the SmartMonitor and used to detect respiratory effort. When the impedance change is not great enough for the SmartMonitor to detect that respiratory effort has occurred, the APNEA light will come on and the audible alarm will sound. The electrodes on the thoracic cavity also detect the signals caused by the electrical changes produced by the heart. The SmartMonitor is thus able to determine the heart rate.

****WARNING****

**Healthdyne SmartMonitors can detect certain types of apneas and heart activity. (The monitor will detect the presence of apnea unless the baby is choking or moving his or her body.) SmartMonitors will not prevent or restore the loss of breathing and heart activity. The SmartMonitor will not prevent death. Therefore, anyone using this device to monitor an infant should be trained in current infant Cardiopulmonary Resuscitation (CPR), which is a proper way to restore breathing and heart activity. Refer to Chapter XV, Warnings and Cautions, page 57, for additional information.**

### How the Alarms Operate

Included in the design of the SmartMonitor are features that allow for different limits to be set for each of the patient alarms. Whenever the patient's respiratory effort and heart rate are not within the prescribed boundaries, an indicator light will turn on and the audible alarm will sound.

The Models 900S, 900SL, 950S, and 970S SmartMonitors have two types of audible alarms:

1. an intermittent or "beeping" alarm indicating one of the following alarm events: APNEA, HIGH or LOW HEART, or Low Breath Rate.
2. a constant alarm indicating LOOSE CONNECTION, LOW BATTERY, FULL MEMORY (or Memory Almost Full) events, or an Accidental Power-Off.

****CAUTION****

During home set-up, test to see if you can hear the alarm from different rooms while there is noise in the house. Sound the alarm on the SmartMonitor and move to different areas in the home. If the alarm is not loud enough to hear around the home, provide a Model 990 Remote Alarm. This device will allow the parent(s) to hear the alarm from a different room from where the Monitor is located.

### How the Internal Memory Operates

The SmartMonitor (except Model 900S) contains an electronic memory system which automatically documents monitor usage and alarms. The SmartMonitor is equipped with a dual-level memory alarm. When the memory is 80% full, the SmartMonitor will alarm and can be silenced by pressing the ALARM RESET button. Monitoring can continue. When the memory is 100% full, the alarm sounds again, but can still be silenced by the ALARM RESET button. Monitoring can continue; however, the earliest events recorded will be replaced with the most recent events.

# III. UNPACKING AND INSPECTION

When you receive the SmartMonitor, unpack the shipping case and carefully examine the contents. Save the shipping carton. Make sure that you have all the necessary items and that they are not damaged. Anything missing or damaged should be reported to your dealer or to Healthdyne.

The SmartMonitor home package should include the following:

(1) SmartMonitor
(1) 901 Soft Carrying Case
(1) 908 Patient Cable
(1) 913 Battery Charger
(1) 922 Home Operator's Manual
(3) 9520 Safety Lead Wires, pin-to-socket
(2) 16510 Reusable Electrodes
(1) 16530 Electrode Belt

A label is included with the manuals which summarize the proper steps to turn off power, correct an improper power-off, and enter the communications mode. If you decide to use the label, remove the paper backing and apply it to the smooth surface on top of the SmartMonitor.

**NOTE:** If the SmartMonitor you are using is identified as Type 01 or 1A on the serial number label (bottom panel), contact Healthdyne Service immediately at (800) 421-8754.

# IV. HOME SET-UP OVERVIEW

This section is an overview of the basic steps required to set-up a SmartMonitor on a patient at home. ***Read the entire manual prior to relying upon this page (alone) to set up a SmartMonitor.***

(1) Remove the bottom panel display cover, power on, and press PRIOR, NEXT, NEXT, ENTER, ENTER, ENTER to place the SmartMonitor in the Menu Mode.

(2). Set the alarm and record parameters according to the physician's prescription.

If the SmartMonitor is to be used with a Modem, be sure to program the Modem-Cable to match the Modem to be used.

If the SmartMonitor is to be used with an oximeter, be sure to program Channel 3 to PULSE, and Channel 4 to $SpO_2$.

If this is a new set-up, or if the SmartMonitor memory has just been downloaded, be sure to clear the memory.

(3) Pack the SmartMonitor for delivery to the patient. Include the following accessories: 901 Soft Carrying Case, 908 Patient Cable, 913 Battery Charger power supply, 922 Home Manual, Event Log Sheet, 977 Spanish Overlay Kit*, 9520 Lead Wires, 16510 Electrodes, 16530 Electrode Belt, 16936 or 16936-07 Parents Guide to Infant Monitoring*, 970VHS or 970VHS-S Parent Training Tape*, 937 CPR Poster Set*, 990 Remote Alarm*, 9175 Body Position Sensor*, 975/2400V/9600V Modem* with 9140/9141 Modem Cable.

*Optional Accessories

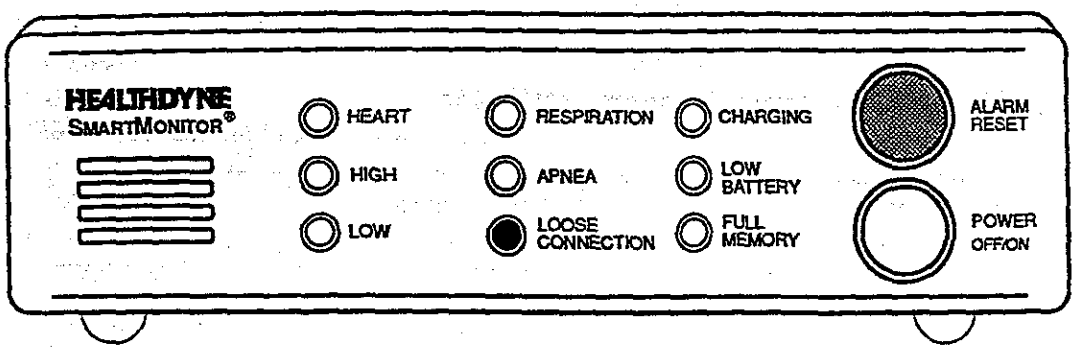
(4) Review use of the SmartMonitor and its accessories with parent(s). Be sure to demonstrate the Functional Self-Test, and encourage them to use this test at least weekly, or whenever lead wires, patient cables, or electrodes are changed.

- Stress the importance of electrode positioning, belt snugness, clean electrodes, and clean skin.
- Explain to the parent(s) what steps to take when the FULL MEMORY alarm occurs.

(5) Leave your emergency phone number(s) and procedures with the parent(s).

# V. FEATURES

## Front-panel Features




### POWER OFF/ON

Push the POWER OFF/ON button to turn the SmartMonitor on. The lights and the audible alarm will come on briefly. After a ten-second pause, monitoring will begin. To turn the SmartMonitor off, follow these steps:

- Press and **hold** the blue ALARM RESET button.
- Press and release the white POWER OFF/ON button.
- Wait two seconds, then release the ALARM RESET button.

If the POWER OFF/ON button is pushed without first pressing and holding the ALARM RESET button, the alarm will sound continuously. If this should happen, press the POWER OFF/ON button again - the SmartMonitor has to detect a power ON before it will allow another power OFF. Then follow the steps stated above to turn the SmartMonitor off.

### ALARM RESET

The blue ALARM RESET button is used to reset the alarm lights on the SmartMonitor after the conditions that caused the light(s) to come on are corrected. Additionally, the only audible equipment alarms that can be silenced by pressing the ALARM RESET button are FULL MEMORY (or Memory Almost Full) and LOW BATTERY Warning. Audible patient alarms cannot be silenced with ALARM RESET. Audible patient alarms will, however, stop when the patient signals are within the alarm limits.

### LOOSE CONNECTION

The red LOOSE CONNECTION light may come on when there is a problem with any of the following:

1. lead wires,
2. electrodes,
3. electrode belt,
4. patient cable, or
5. connections between the patient's skin, the electrodes, the lead wires, the patient cable, and the SmartMonitor

After the problem has been corrected, the audible alarm will stop but the red indicator light will remain on until reset by the ALARM RESET button.

## CHARGING

The yellow light is on when the battery inside the SmartMonitor is being charged. It is not an alarm condition. If the Battery Charger is plugged into an outlet and connected to the SmartMonitor, the CHARGING light should be on.

## 80% FULL MEMORY - Type 02 SmartMonitors Only

When the SmartMonitor's memory is approximately 80% full, the alarm will sound continuously and the light will come on. Pressing the ALARM RESET button will silence the alarm, and the FULL MEMORY light will change from constant to flashing for two seconds every 30 seconds until the condition is corrected (the memory is transferred and then cleared).

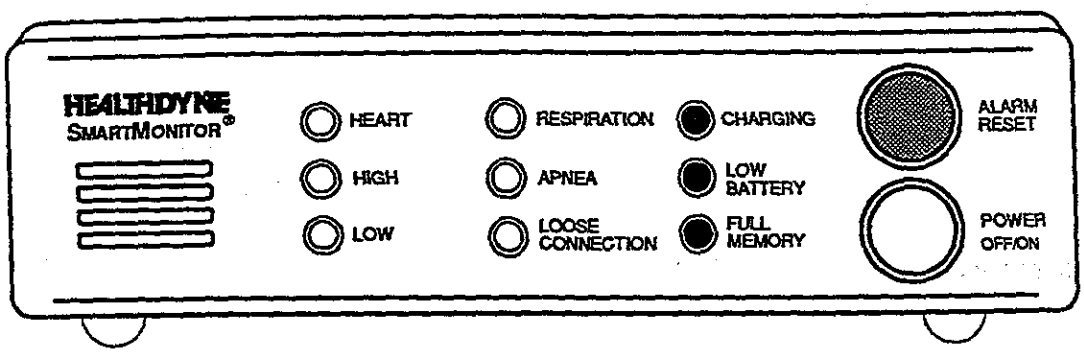
## 80% FULL MEMORY - Type 1B, 1C SmartMonitors Only

When the SmartMonitor's memory is approximately 80% full, the FULL MEMORY light will blink for two seconds every 30 seconds and the alarm will sound continuously. Pressing the ALARM RESET button will silence the alarm, but the light will continue to flash until the condition is corrected (the memory is transferred and then cleared).

## 100% FULL MEMORY

When the SmartMonitor's memory is 100% full, the FULL MEMORY light will change from flashing to constant and the audible alarm will sound again. Press the ALARM RESET button to silence the alarm. The oldest recorded waveforms will be lost if monitoring continues (first in, first out). The most recent information will always be stored in the memory.

**NOTE:** If a FULL MEMORY or Memory Almost Full condition exists, the alarm will sound every time the SmartMonitor is powered on. Press the ALARM RESET button to silence the alarm.




## LOW BATTERY - Type 02 SmartMonitors Only

When the battery voltage is too low for the SmartMonitor to operate properly, the audible alarm will sound continuously and the red LOW BATTERY light will come on. Press the ALARM RESET button to silence the audible alarm - the red light will turn on for two seconds every 30 seconds until the batteries reach a minimal charge level.

To charge the batteries, plug the Battery Charger into the back of the SmartMonitor (POWER INPUT) and into a properly grounded electrical outlet. The red LOW BATTERY light will go off only after the batteries reach a minimal charge level. Fully depleted batteries require approximately 24 hours to recharge. Less time is needed for partially drained batteries - for each hour the batteries are in operation, they should be charged for at least 1 hour.

If the LOW BATTERY alarm condition is not corrected and monitoring continues without connecting and plugging in the Battery Charger, the LOW BATTERY alarm will sound again and the light will remain constant. **Under these conditions, the SmartMonitor's batteries do not have enough power to continue to operate properly and automatic power shutdown will occur.** The Battery Charger can be used at this time to charge the batteries; however, the only way to silence the audible alarm is to use the proper Power-Off sequence (press and hold the ALARM RESET button, press and release POWER OFF/ON, wait two seconds, and then release the ALARM RESET button).

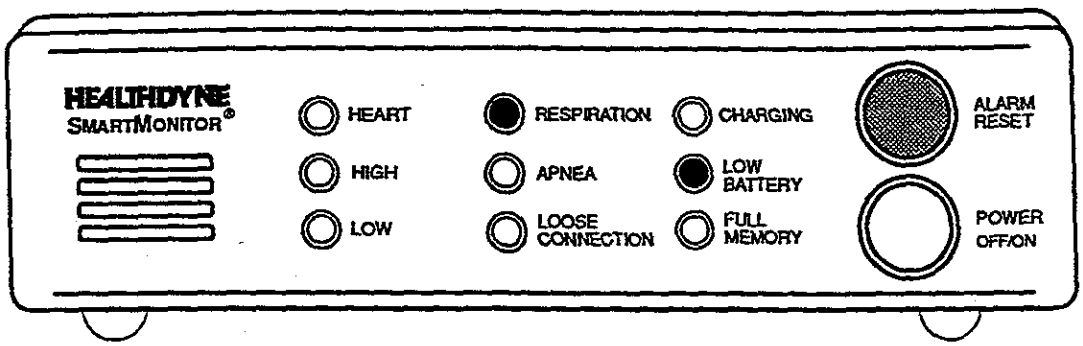
**LOW BATTERY - Type 1B, 1C SmartMonitors Only**

When the battery voltage is too low for the SmartMonitor to operate properly, the alarm will sound continuously for one second. The red LOW BATTERY light will then turn on for two seconds every 30 seconds until the condition is corrected.

To charge the batteries, plug the Battery Charger into the back of the SmartMonitor (POWER INPUT) and into a properly grounded electrical outlet. The red LOW BATTERY light will go off only after the batteries reach a minimal charge level. Fully depleted batteries require about 24 hours to recharge. Less time is needed for partially drained batteries — for each hour the batteries are in operation, they should be charged for at least 1 hour.

If the LOW BATTERY condition is not corrected and monitoring continues without connecting the Battery Charger, the LOW BATTERY alarm will sound continuously and the light will remain constant. **Under these conditions, the SmartMonitor batteries do not have enough power to continue to operate properly and automatic power shutdown will occur.** The Battery Charger can be used at this time to charge the batteries; however, the only way to silence the audible alarm is to use the proper Power-Off sequence (press and hold the ALARM RESET button, press and release POWER OFF/ON, wait two seconds, and then release the ALARM RESET button.)

**CAUTION:** If the SmartMonitor is not being portably operated, Healthdyne recommends keeping the Battery Charger connected and plugged into a properly grounded outlet at all times. The batteries cannot be overcharged.




**RESPIRATION**

The green RESPIRATION light will blink with each respiratory effort movement that the SmartMonitor detects. The light should blink only once for each breath; although, it may flash additional times when the baby is moving. Listen and watch the baby breathe. If this light flashes more or fewer times that the baby breathes, contact the equipment provider.

**APNEA**
The red APNEA light will come on and the audible alarm will "beep" once per second when the SmartMonitor detects a pause in respiratory effort that is longer that the physician prescribed APNEA DELAY setting. When the SmartMonitor detects that respiratory effort has resumed, the "beeping" alarm will stop, but the red light stays on until reset by the ALARM RESET button.

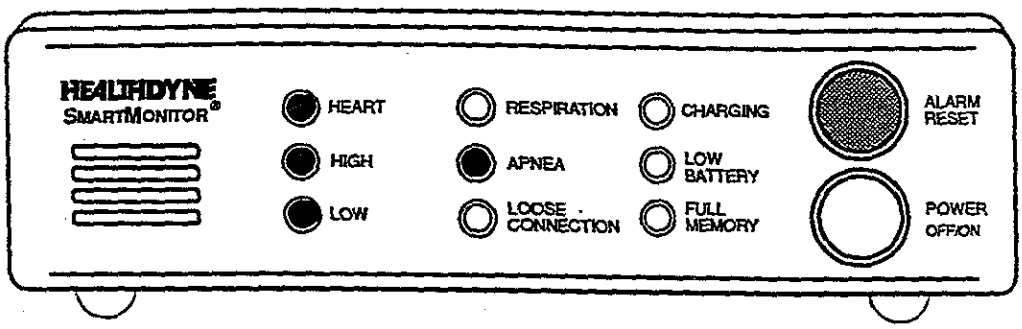
Some apneas may be missed by apnea monitors. The monitors may mistake body movement for breathing. If a baby has apnea due to choking, the monitor could mistake movement caused by choking for breathing. However, the monitor will detect most apneas not caused by choking or movement.

The APNEA light is also used to signal another parameter, LOW BREATH RATE. If the breath rate (as determined by respiratory effort) falls below the LOW BREATH RATE setting (but pauses are not long enough to trigger an APNEA alarm), the APNEA light will flash twice per second, and the alarm with "beep" once per second. If the SmartMonitor detects an apneic episode during a LOW BREATH RATE alarm, the apnea will take precedence — the APNEA light will change from flashing to constant. Use of the LOW BREATH RATE alarm is recommended with adults only.

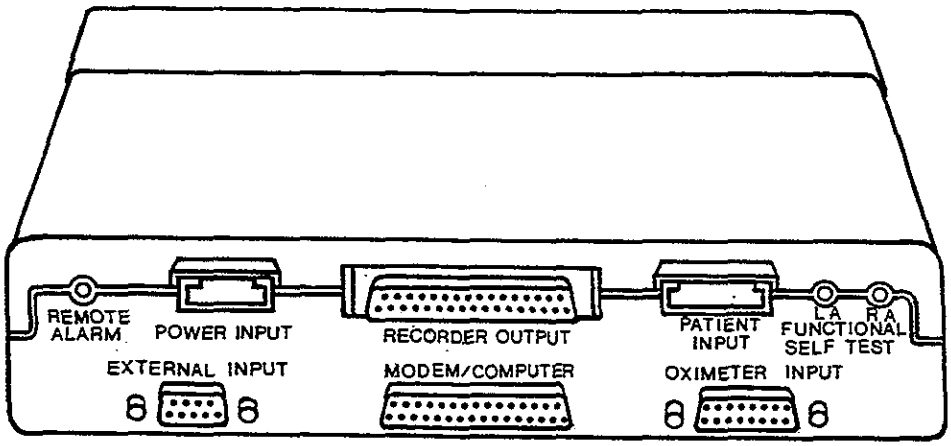
**HEART**
The green light marked "HEART" blinks with each heartbeat that the SmartMonitor detects. The monitor detects the "R-waves" from the patient's "PQRST" complex.

**HIGH**
The red light marked "HIGH" will come on and the audible alarm will "beep" twice per second when the SmartMonitor determines that the heart rate is higher than the TACHYCARDIA setting. The "beeping" alarm will stop when that condition no longer exists, but the red light stays on until reset by the ALARM RESET button.

**LOW**
The red light marked "LOW" will come on and the audible alarm will "beep" once per second when the SmartMonitor determines that the heart rate is lower than the BRADYCARDIA setting. The "beeping" alarm will stop when that condition no longer exists, but the red light stays on until reset by the ALARM RESET button.



## Rear-panel Features




**REMOTE ALARM OUTPUT**
The REMOTE ALARM OUTPUT connector is used with the Healthdyne Model 990 (battery-powered) Remote Alarm or the Model 16100 (line-powered) Remote Alarm. Either Remote Alarm can be used when the caretaker wants to monitor the audible alarm from a different room.

**POWER INPUT**
The POWER INPUT connector is used with the Healthdyne Model 913 Battery Charger. The Battery Charger should be used whenever the SmartMonitor is not being used portably (on battery power only).

**RECORDER OUTPUT**
The RECORDER OUTPUT connector is used with various recording equipment including the 6100 Data Recorder, 16800 Trend/Event Recorder, 9100 Event Recorder, and 16202 Cassette Recorder. Refer to page 56 for connector pin assignments.

**PATIENT INPUT**
The PATIENT INPUT connector is used with the Healthdyne Model 908 Patient Cable.

**FUNCTIONAL SELF-TEST OUTPUT**
The FUNCTIONAL SELF-TEST connectors are used with Healthdyne Model 9520 Lead Wires when performing the Functional Self-Test. Refer to page 31 for details.

**OXIMETER INPUT**
The OXIMETER INPUT connector is used with the Healthdyne Model 9130 or 9130N Cable to interface a Healthdyne 930 Oximeter to the memory system of the SmartMonitor. Other oximeters such as Nellcor and Ohmeda may be connected to the SmartMonitor using the 9132 Cable. Refer to the Using an Oximeter section on page 46 for details. Refer to page 56 for connector pin assignments.

**EXTERNAL INPUT**
The EXTERNAL INPUT connector is used with external monitoring equipment when Channel(s) 3 or 4 are programmed to EXTERNAL. (There is another connector for an Oximeter). Through the EXTERNAL INPUT connector, external physiological signals (other than oximetry) are connected to the internal memory system of the SmartMonitor (and thus recorded along with the SmartMonitor's signals). Alarm signals from external devices can also be interfaced (for research purposes) to the SmartMonitor via this connector.

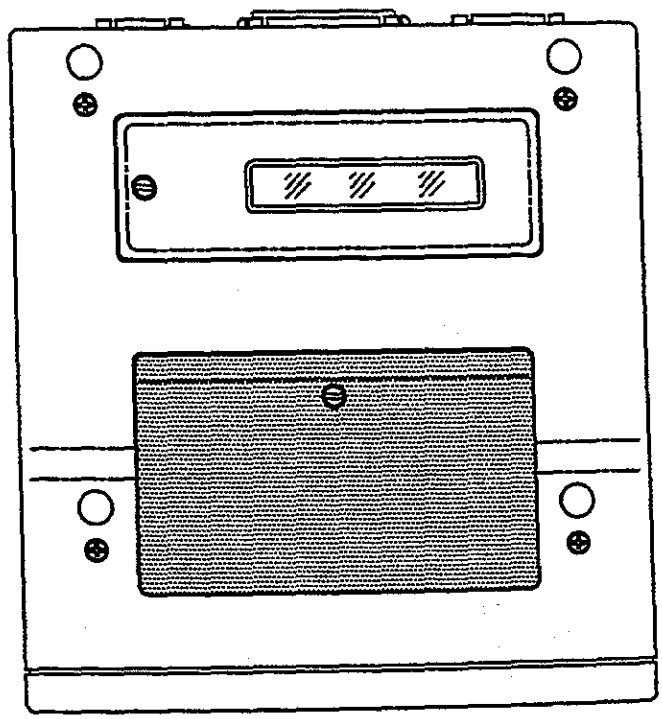
Using the Model 9134 (mini phone plugs for channel 3 and channel 4) or 9136 Cable (no connectors for channel 3 and channel 4), other signals can be interfaced to the SmartMonitor. Refer to page 56 for connector pin assignments. Refer to the Operating Instructions (pages 19-21) for details on programming the SmartMonitor to use signals from the EXTERNAL INPUT connector.

**MODEM/COMPUTER**
The MODEM/COMPUTER connector is used with the Healthdyne Model 9140 or 9141 Cable when interfacing to the Modem, and the Model 9150 or 9151 Cable when interfacing to a Series 9500 Computer.

Refer to the Chapter XII, *Using the 982 or 980 Memory Module*, on page 51, or to the 9500 Computer System Operator's Manual for communications instructions.

## Bottom-Panel Features

**BATTERY COMPARTMENT**
The NiCad battery pack is accessible through the bottom panel cover, which can be removed by loosening one screw. Refer to page 54 for complete battery replacement instructions.



****WARNING****
**Do not operate the SmartMonitor with the battery pack removed, and with the Battery Charger connected. There is no power loss alarm feature under these conditions.**

## Special Features

### ACCIDENTAL POWER-OFF

The SmartMonitor is equipped with an accidental Power-Off audible alarm (often referred to as a "sibling" alarm). This feature causes a continuously sounding alarm if the SmartMonitor is not turned off in the correct way:

- Press and **hold** the blue ALARM RESET button.
- Press and release the white POWER OFF/ON button.
- Wait two seconds, then release the ALARM RESET button.

### FUNCTIONAL SELF-TEST

The SmartMonitor has a special feature called the FUNCTIONAL SELF-TEST. This test is the best way to quickly determine if the SmartMonitor and the accessories are operating properly. Refer to pages 31-33 for FUNCTIONAL SELF-TEST instructions.

The Functional Self-Test should be performed:

1. When the equipment is first set up,
2. When the patient cable or lead wires are changed,
3. On a regular basis (as a general rule, at least once a week).

### PARAMETER DISPLAY ACCESS - Type 02 SmartMonitors

Although all parameters (alarm and recording settings) are inaccessable to parents, a cut-out in the display cover allows parents to check for error messages and verify when the SmartMonitor in in the Communications Mode. To gain access to the parameter display menu, follow the Operating Instructions on page 13.

The parameter display menu has 24 entries which are presented in a continuous loop. The entries are presented in the following order:

1. Standard Alarm Parameters Status
2. Standard Record Parameters Status
3. Apnea Alarm Time Delay
4. Low Breath Rate Alarm
5. Bradycardia Alarm
6. Bradycardia Alarm Delay
7. Tachycardia Alarm
8. Record Mode
9. Pre/Post Time
10. Respiration Waveform Record
11. Apnea for Record Time Delay
12. Heart Rate Trend Signal Record
13. ECG QRS Waveform Record
14. Channel 3 Record
15. Channel 4 Record
16. External Alarm 1
17. External Alarm 2
18. Time
19. Date
20. Modem-Cable
21. Software Revision Level
22. Serial Number
23. Memory Status
24. Clear Memory?

**NOTE:** Items 9, 10, 12, 13, 14, and 15 do not apply to 900SL SmartMonitors.

## PARAMETER DISPLAY ACCESS - Type 1B, 1C SmartMonitors Only

All parameters (alarm and recording settings) are hidden from parental view by a display cover. To gain access to the parameter display menu, follow the Operating Instructions on page 13.

The parameter display menu has 22 entries which are presented in a continuous loop. The entries are presented in the following order:

1. Standard Alarm Parameters Status
2. Standard Record Parameters Status
3. Apnea Alarm Time Delay
4. Low Breath Rate Alarm
5. Bradycardia Alarm
6. Bradycardia Alarm Delay
7. Tachycardia Alarm
8. Record Mode
9. Pre/Post Time
10. Respiration Waveform Record
11. Apnea for Record Time Delay
12. Heart Rate Trend Signal Record
13. ECG QRS Waveform Record
14. Channel 3 Record
15. Channel 4 Record
16. External Alarm 1
17. External Alarm 2
18. Time
19. Date
20. Computer Phone Number
21. Software Revision Level
22. Serial Number

## STANDARD VALUES*

To enable fast setup, a set of "standard" values has been predefined. These default values represent commonly used monitoring and recording settings for newborn infants. The standard values, which are printed on the inside of the display cover, are:

| Parameter | Value 900S, 900SL, 950S, 970S | Alarm or Record Parameter? |
|---|---|---|
| Apnea Alarm Time Delay | 20 seconds | Alarm |
| Low Breath Rate Alarm | Off | Alarm |
| Bradycardia Alarm | 80 BPM | Alarm |
| Bradycardia Alarm Delay | Off | Alarm |
| Tachycardia Alarm | 230* | Alarm |

| | 900S | 900SL | 950S | 970S | |
|---|---|---|---|---|---|
| Record Mode | N/A | Event Log | Event | Event | Record |
| Pre/Post Time | N/A | N/A | 30/15 | 30/15 | Record |
| Respiration | N/A | N/A | On | On | Record |
| Apnea Record (sec) | N/A | 16 | 16 | 16 | Record |
| HR Trend | N/A | N/A | On | On | Record |
| ECG QRS Waveform | N/A | N/A | Off | On | Record |
| Channel 3 Record | N/A | N/A | Off | Off | Record |
| Channel 4 Record | N/A | N/A | Off | Off | Record |
| Ext. Alarm 1 Status | N/A | Off | Off | Off | Record |
| Ext. Alarm 2 Status | N/A | Off | Off | Off | Record |

**NOTE:** For Type 1B, 1C SmartMonitors, the Tachycardia standard value is OFF. For Type 02 SmartMonitors, the standard Modem-Cable is 2400MNP-9141.

**NOTE:** The Model 900SL SmartMonitor should be operated identically to the Models 900S, 950S and 970S except that the standard Record Mode is EVENT LOG.

* Healthdyne does not intend to imply that the values used in our "standard" designation are ***the*** standard values for monitoring use — they simply represent commonly used settings for newborn infants.

# VI. OPERATING INSTRUCTIONS

## The Parameters Display Menu

### GAINING ACCESS TO THE PARAMETERS DISPLAY MENU

All alarm and recording settings are selected using the Parameters Display Menu. (Settings can be adjusted manually via this menu, by Phone Modem Communications, or by Direct Communications with Cable.) Accessing the Parameters Display Menu puts the SmartMonitor in the Menu mode. The Type 02 SmartMonitor will beep once every 10 seconds to signal that it is in the Menu mode. If the SmartMonitor is a Type 1B or 1C, it will beep once every 30 seconds to signal that it is in the Menu mode.

**Important:** Do not make changes and then implement the STD (standard) Parameters. Once the new values are selected, turn the SmartMonitor OFF and then ON. This will implement the new values.

To set the alarm and recording settings manually, remove the display cover with a screwdriver and then follow the steps listed below:

(1) **Press the POWER OFF/ON button to ON. The display should read: MENU MODE? ENTER PROPER KEY SEQUENCE.**

(2) **Then press the keys in the following sequence within 10 seconds: PRIOR, NEXT, NEXT, ENTER, ENTER, ENTER.**

The display should read one of the messages below:

"STD ALARM PARAMETERS ARE SELECTED"
or
"STD ALARM PARAMETERS NOT SELECTED"

(3) **A. If no change from the standard alarm parameters is required, and the message displayed is "STD ALARM PARAMETERS ARE SELECTED," proceed to (4).**

**B. If the standard alarm parameters are required but not selected:**

- Press the ENTER key. The display will flash "NOT SELECTED."
- Press NEXT to change the display to "YES."
- Press ENTER to program the change. The display will read: "STD ALARM PARAMETERS ARE SELECTED."

**NOTE: When the SmartMonitor is powered OFF and then ON, the new values (standard) will be implemented in the SmartMonitor. If you continue through the menu and change one of the alarm parameters, this display (STD ALARM PARAMETERS ARE SELECTED) will automatically change to "STD ALARM PARAMETERS NOT SELECTED."**

(4) **Press NEXT and the message displayed should be one of the following:**

"STD RECORD PARAMTRS. ARE SELECTED"
or
"STD RECORD PARAMTRS. NOT SELECTED"

A. If no change from the standard record parameters is required, and the message displayed is "STD RECORD PARAMTRS. ARE SELECTED," replace the display cover, and turn the SmartMonitor off.

B. If the standard record parameters are required but not selected:

- Press the ENTER key. The display will flash "NOT SELECTED."
- Press NEXT to change the display from "NOT SELECTED" to "YES."
- Press ENTER to program the change.

The display will read "STD RECORD PARAMTRS. ARE SELECTED." When the SmartMonitor is powered OFF and then ON, the new values (standard) will be implemented in the SmartMonitor. If you continue through the menu and change one of the record parameters, this display (STD RECORD PARAMTRS. ARE SELECTED) will automatically change to "STD RECORD PARAMTRS. NOT SELECTED."

**NOTE:** Since the 900S SmartMonitor does not have internal memory, attempts to change the Record Mode from OFF will be ignored. Additionally, the 900SL, 950S, and 970S SmartMonitors have different Standard Record Parameters as noted in Standard Values, page 13.

(5) **If the prescribed alarm/record settings are different from standard parameter values, follow the directions listed in Changing the Parameters Display Menu.**

## CHANGING THE PARAMETERS DISPLAY MENU

Only three buttons are used to control the menu: ENTER, NEXT and PRIOR. The menu has 24 (22 for Type 1B, 1C SmartMonitors) entries which are presented in a continuous loop. When Entry 1 is displayed (Standard Alarm Parameters), pressing NEXT causes Entry 2 to be displayed (Standard Record Parameters), and pressing PRIOR causes Entry 24 to be displayed (Clear Memory?). Any menu entry can be displayed using the NEXT and PRIOR keys.

**To make a change in the menu entry:**

(1) Press the ENTER key. The value for that SmartMonitor parameter will flash, indicating changes can be made.
(2) Use the NEXT or PRIOR keys to change the parameter to the desired value.
(3) When the desired value is displayed, press ENTER to program the value.
(4) To continue to a different menu entry, press NEXT or PRIOR. Each new value selected will be implemented when the SmartMonitor is powered OFF, then ON (except Date and Time which are instantly implemented).
(5) Exit the Parameters Display Menu. Turn the SmartMonitor power off:
- Press and hold the blue ALARM RESET button.
- Press and release the white POWER OFF/ON button.
- Wait two seconds, then release the ALARM RESET button.

Follow the steps in Changing the Parameters Display Menu (previous page) to make the desired changes in each menu entry. Menu entries 21 and 22 are for information only and cannot be changed.

**The next eighteen sections list the details of each menu entry (parameter).**

**Apnea Alarm Time Delay**

The Apnea Alarm Time Delay parameter establishes the amount of time delay from the onset of detected apnea to activation of the APNEA alarm. The display for setting the Apnea Alarm Time Delay is:

APNEA ALARM
xx SEC

The value options are: 10, 15, 20, 25, 30 or 40 seconds.

**Low Breath Rate Alarm**

The Low Breath Rate parameter establishes the alarm setpoint based upon frequency of detected respiratory effort. The display for setting the low breath rate alarm is:

LOW BREATH RATE
xx BrPM

The value options are: Off, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 25 or 30 BrPM.

**Bradycardia Alarm**

The Bradycardia Alarm parameter establishes the LOW heart rate alarm setpoint based upon the current average of detected "R-wave" intervals. The display for setting the Bradycardia Alarm is:

BRADYCARDIA
xxx BPM

The value options are: 10, 20, 30, 40, 50, 60, 70, 80, 90 or 100 BPM.

**Bradycardia Alarm Delay**

The Bradycardia Alarm Delay enables introduction of a 5-second delay to the audible alarm. The display for setting the Bradycardia Alarm Delay is:

BRADY ALARM DELAY
x SECONDS

The value options are: 0 or 5 seconds.

If the Bradycardia Alarm Delay is set to 5 seconds, the audible alarm is not activated unless the alarm setpoint is violated for 5 seconds or more. The purpose of the alarm delay is to reduce the number of short (<5 sec.) Bradycardia alarms. This physician decision should be based upon factors such as the known condition of the patient, number of short Bradycardia alarms reported or documented by the SmartMonitor, the current Bradycardia alarm setpoint, and the patient's average resting heart rate.

**NOTE:** When the RECORD MODE is set to EVENT, waveforms are recorded as soon as the Bradycardia setpoint is violated, regardless of whether the Bradycardia Alarm Delay is 0 or 5 seconds. In other words, the Bradycardia Alarm Delay setting does not affect event recordings.

## Tachycardia Alarm

The Tachycardia Alarm parameter establishes the HIGH heart rate alarm setpoint based upon the current average of detected "R-wave" intervals. The display for setting the Tachycardia Alarm is:

TACHYCARDIA
xxx BPM

The value options are: OFF, 90, 100, 110, 130, 150, 170, 190, 210, 230, 250 or 270 BPM.

## Record Mode

The Record Mode parameter establishes the mode of the internal memory system. The display for setting the Record Mode is:

RECORD MODE
xxxxxxxxxxx

The mode options are: EVENT, CONTINUOUS, EVENT LOG, or OFF.

**Event Mode** - Active waveforms are recorded each time a patient parameter is violated. The patient parameters are Apnea, Apnea for Record, Bradycardia, Tachycardia, Low Breath Rate, Oximeter and External Alarm 1. The event number, description, date, time and duration of each alarm are entered in the Patient Events Log in addition to waveforms. Also, all equipment related events are entered in the Equipment Events Log.

**Event Log Mode** - When in the Event Log Mode, patient alarms are acknowledged by an entry in the Patient Events Log, but no waveforms are recorded. The event number, description, date, time and duration of each patient alarm are entered in the Patient Events Log. Also, all equipment related events are entered in the Equipment Events Log.

**NOTE:** The 900SL SmartMonitor can only be set to Event Log or Off since no waveforms are recorded.

**Continuous Mode** - When in the Continuous Mode, active waveforms are recorded continuously, regardless of alarm conditions. The Patient Events Log registers one entry, a "continuous" event, every time the SmartMonitor power is turned ON to monitor. Also, all equipment related events are entered in the Equipment Events Log.

**Off Mode** - When in the Off Mode, the recording system is disabled. No waveforms or logs are recorded.

| RECORD MODE | 970S | 950S | 900SL | 900S |
|---|---|---|---|---|
| EVENT | ● | ● | | |
| EVENT LOG | ● | ● | ● | |
| CONTINUOUS | ● | ● | | |
| OFF | ● | ● | ● | ● |

**NOTE:** Since the 900S SmartMonitor does not have internal memory, it does not allow any other option besides "OFF" to be selected for Record Mode. Attempts to select another parameter will cause the SmartMonitor to "beep".

Typical memory capacity of a Model 970S (set to Standard Values) is illustrated in the following table. Model 950S capacity is 25% of the 970S values.

| | Memory Capacity | |
|---|---|---|
| **Waveform Channel(s) Active** | **Event Mode** | **Continuous Mode** |
| Respiration<br>Heart Rate Trend | 400-500 events | 10.5 hours |
| Respiration<br>Heart Rate Trend<br>ECG QRS | 50-65 events | 60 minutes |
| Respiration<br>Heart Rate Trend<br>ECG QRS<br>Pulse or External<br>SpO2 or External | 40-55 events | 55 minutes |
| Respiration<br>Heart Rate Trend<br>Pulse or External<br>SpO2 or External | 200-250 events | 5 hours |
| Pulse or External<br>SpO2 or External | 400-500 events | 10.5 hours |
| SpO2 or External | 500 events | 16.8 hours |

## Pre/Post Time

The Pre/Post Time parameter establishes the minimum duration of waveforms recorded with each patient parameter violation. The display for setting the Pre/Post Time is:

PRE/POST TIME
xx/xx SECONDS

The value options are: 75/15, 60/15, 45/15, 30/15, 15/30*, 30/30*, 15/75, 30/60, 45/45 or 60/30 seconds.

*Type 02 and later SmartMonitors only.

The "pre" time defines the number of seconds of waveforms that will be recorded preceding the patient parameter violation. The"post" time defines the number of seconds of waveforms that will be recorded following the end of the patient parameter violation. The total amount of waveform time recorded is equal to the sum of the pre-time, primary plus secondary alarm durations, and post-time.

## Respiration Waveform Record

The Respiration Waveform Record parameter determines whether or not the respiration waveform will be recorded in the Event or Continuous Record Modes. The display for selecting the Respiration waveform is:

RESP RECORDING
xx

The options are: ON or OFF.

## Apnea for Record Time Delay

The purpose of the Apnea for Record Time Delay is to allow active waveforms to be recorded during respiratory pauses prior to activation of the Apnea alarm. The display for setting the Apnea for Record is:

APNEA FOR RECORD
xx SECONDS

The value options are: OFF; or 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28 or 30 seconds.

If the APNEA alarm is set to 20 seconds, and the Apnea for Record is set to 16 seconds, the system will perform as follows:

- For a respiratory pause of 15 seconds, no waveforms will be recorded, and no alarm will occur.
- For a respiratory pause of 18 seconds, waveforms will be recorded (pre/post time + 2 seconds duration), but no alarm will occur.
- For a respiratory pause of 23 seconds, waveforms will be recorded (pre/post time + 7 seconds duration), and there will be a 3-second alarm.

**NOTE:** Type 1B and 1C SmartMonitors do not display this parameter when in the EVENT LOG mode. Apneas will be logged, however, according to the Apnea for Record setting prior to changing the Record Mode to EVENT LOG.

## Heart Rate Trend Signal Record

The Heart Rate Trend Signal Record parameter determines whether or not the Heart Rate Trend (cardiotach) signal will be recorded in the Event or Continuous Record Modes. The display for selecting the Heart Rate Trend signal is:

HR TREND RECORDING
xx

The options are: ON or OFF.

## ECG QRS Waveform Record

The ECG QRS Waveform Record parameter determines whether or not the ECG QRS waveform will be recorded in the Event or Continuous Record Modes. The display for selecting the ECG QRS waveform is:

QRS RECORDING
xx

The options are: ON or OFF.

## Channel 3 Record

The Channel 3 Record parameter determines which, if any, waveforms will be recorded on Channel 3. The display for selecting the Channel 3 waveform is:

CHANNEL 3 RECORDING
xxx

The options are: OFF, PULSE or EXTERNAL.

**OFF** - When the Channel 3 Record parameter is set to OFF, Channel 3 is disabled.

**PULSE** - When the Channel 3 Record parameter is set to PULSE, Channel 3 is programmed to record the pulse (or pulse rate) signal from the OXIMETER INPUT connector of the SmartMonitor.

**EXTERNAL** - When the Channel 3 Record parameter is set to EXTERNAL, Channel 3 is programmed to record the signal on pin 1 of the EXTERNAL INPUT connector of the SmartMonitor.

**NOTE:** Refer to page 56 for pin assignment details in the EXTERNAL INPUT connector.

**NOTE:** When Channel 3 is set to PULSE or EXTERNAL, Channel 3 is active, regardless of whether or not signals are connected to the OXIMETER or EXTERNAL INPUT connectors. Therefore, a flat line will be recorded and reported (via the Series 9500 Computer Systems) if Channel 3 is active, but signals are not connected to the SmartMonitor.

## Channel 4 Record

The Channel 4 Record parameter determines which, if any, waveforms will be recorded on Channel 4. The display for selecting Channel 4 waveform is:

CHANNEL 4 RECORDING
xxx

The options are: OFF, SpO2 or EXTERNAL.

**OFF** - When the Channel 4 Record parameter is set to OFF, Channel 4 is disabled.

**$SPO_2$** - When the Channel 4 Record parameter is set to SpO2, Channel 4 is programmed to record the oxygen saturation signal from the OXIMETER INPUT connector of the SmartMonitor.

**EXTERNAL** - When the Channel 4 Record parameter is set to EXTERNAL, Channel 4 is programmed to record a signal from pin 2 of the EXTERNAL INPUT connector of the SmartMonitor.

**NOTE:** Refer to page 56 for pin assignment details in the EXTERNAL INPUT connector.

**NOTE:** When Channel 4 is set to SpO2 or EXTERNAL, Channel 4 is active, regardless of whether or not signals are connected to the OXIMETER or EXTERNAL INPUT connectors. Therefore, a flat line will be recorded and reported (via the Series 9500 Computer Systems) if Channel 4 is active, but signals are not connected to the SmartMonitor.

## External Alarm 1

The External Alarm 1 parameter determines whether or not an externally generated signal is to be used to trigger waveform recordings. The purpose of this feature is to allow the SmartMonitor to record waveform events based on the status of external equipment. ***This feature is used by researchers, and should always be OFF for typical home setups.*** The display for selecting the External Alarm 1 mode is:

EXTERNAL ALARM 1
xxx

The options are: OFF, HIGH or LOW.

**OFF** - When the External Alarm 1 parameter is set to OFF, the SmartMonitor memory system cannot be triggered via the EXTERNAL INPUT connector.

**HIGH** - When the External Alarm 1 parameter is set to HIGH, the SmartMonitor memory system will record active waveforms whenever pin 3 on the EXTERNAL INPUT connector is between +3.5 and +5.0 VDC.

**LOW** - When the External Alarm 1 parameter is set to LOW, the SmartMonitor memory system will record active waveforms whenever pin 3 on the EXTERNAL INPUT connector is between 0.0 and +0.8 VDC.

**NOTE:** If External Alarm 1 is programmed to HIGH or LOW without connecting an alarm signal line to pin 3, waveforms may be triggered continuously, since these conditions simulate a disconnected or broken alarm signal line.

Even though the (Type 1B and 1C only) 900S SmartMonitor displays "External Alarm 1" on the LCD, and allows selection of either HIGH or LOW, these parameters are ignored by the SmartMonitor.

## External Alarm 2

The purpose of the External Alarm 2 parameter is to allow the SmartMonitor to document the status of power supply or alarm lines of external devices. ***This feature is used by researchers, and should always be OFF for typical home setups.*** If External Alarm 2 is activated (i.e., loose connection or power failure), the SmartMonitor will not allow an externally generated signal to trigger waveform recordings even if External Alarm 1 indicated a patient parameter has been violated. The display for selecting the External Alarm 2 mode is:

EXTERNAL ALARM 2
xxx

The options are: OFF, HIGH or LOW.

**OFF** - When the External Alarm 2 parameter is set to OFF, the SmartMonitor memory system is not affected by the EXTERNAL INPUT connector.

**HIGH** - When the External Alarm 2 parameter is set to HIGH, the SmartMonitor memory system will record an entry in the Equipment Events Log whenever pin 4 on the EXTERNAL INPUT connector is between +3.5 and +5.0 VDC. The Equipment Events Log entry will include event number, description (External 2), date, time and duration.

**LOW** - When the External Alarm 2 parameter is set to LOW, the SmartMonitor memory system will record an entry in the Equipment Events Log whenever pin 4 on the EXTERNAL INPUT connector is between 0.0 and +0.8 VDC. The Equipment Events Log entry will include event number, description (External 2), date, time and duration.

**NOTES:** If External Alarm 2 is programmed to HIGH or LOW without connecting an alarm signal line to pin 4, waveforms may be triggered continuously, since these conditions simulate a disconnected or broken alarm signal line.

Even though the (Type 1B and 1C only) 900S SmartMonitor displays "External Alarm 2" on the LCD, and allows selection of either HIGH or LOW, these parameters are ignored by the SmartMonitor.

## Time

The Time parameter indicates the current setting of the internal SmartMonitor clock. The display for selecting the time parameter is:

TIME
xx:xx:xx

When you press ENTER to program the new time, the new numbers will be implemented immediately. This procedure must be repeated for each of the six numbers. The time is always displayed in the 24-hour (military) format (hh/mm/ss = hours/minutes/seconds).

**Date**

The Date parameter indicates the current setting of the internal SmartMonitor calendar. The display for selecting the date parameter is:

DATE
xx/xx/xx

When you press ENTER to program the new date, the new number will be implemented immediately. This procedure must be repeated for each of the six numbers. This date is always displayed in the mm/dd/yy (month/day/year) format.

**Computer Phone Number - Type 1B, 1C Only**

The Computer Phone Number parameter is the number of a Series 9500 Computer System phone line. It is for reference only. The display for the Computer Phone Number is:

COMPUTER PHONE NUMBER
x-xxx-xxx-xxxx

Press ENTER to program the new number; the new number will be implemented immediately. This procedure must be repeated for each of the numbers.

NOTE: The Computer Phone Number has been deleted for Type 02 SmartMonitors and replaced by a Modem-Cable function. Refer to page 23 for the Modem-Cable function.

**Software Revision Level**

The Software Revision Level parameter reflects the revision level of the programmable memory chip contained in the SmartMonitor. The display for the Software Revision Level is:

SOFTWARE REVISION
x

The Software Revision Level display cannot be changed.

**Serial Number**

The Serial Number parameter reflects the permanent (and unique) Serial Number assigned to the SmartMonitor. It should always match the Serial Number plate on the bottom panel of the SmartMonitor. If it does not match, the Serial Number plate has been altered, or a circuit board was installed in the wrong enclosure. You should call the Healthdyne Service Department for further instructions. The display for the Serial Number is:

SERIAL NUMBER
x12345

The Serial Number display cannot be changed.

***The following functions apply only to Type 02 SmartMonitors:**

***Modem-Cable**

The SmartMonitor must be programmed to match the modem to be used. The modem must be used with the proper cable. The display for the Modem-Cable is:

MODEM-CABLE
xxx-xxxx

The options are: 2400MNP-9141, 975-9140, 2400B-9141, and 9600V-9141. Refer to Section VII, beginning on page 34 for details.

***Memory Status**

Memory Status allows the percent full to be indicated for convenience. When the Record Mode is Events or Continuous, the Percent Full calculation refers to the waveform memory capacity of the SmartMonitor. When the Record Mode is Event Log, the Percent Full calculation refers to the Patient and/or Equipment Events Log memory capacity (500 entries each). The 80% Full Memory alarm activates when the waveform memory capacity is 80% full, or the Equipment (or Patient) Events Log memory reaches 400 entries.

The display for the Memory Status is:

MEMORY STATUS
xx PerCent FULL

The Memory Status display cannot be changed.

***Clear Memory?**

Upon choosing NO or YES, the monitor will confirm whether the memory has been cleared or not. The alarm and record parameters will not be cleared; only the waveforms and logs will be cleared. The display for Clear Memory? is:

CLEAR MEMORY?
xx

The options are: YES or NO.

**The memory should be cleared under the following conditions:**

1. After the SmartMonitor has been downloaded, and the data has been saved to a Memory Disk. This prepares the SmartMonitor for the next patient.
2. When the SmartMonitor is being moved from one patient to another. This is necessary to prevent mixing data.
3. After changing the Date or Time, since some Date/Time changes adversely affect the Compliance Report and/or Equipment Events Log.
4. Whenever the SmartMonitor has been stored prior to use on a patient. This will reset the compliance start Date/Time to match application on the patient.

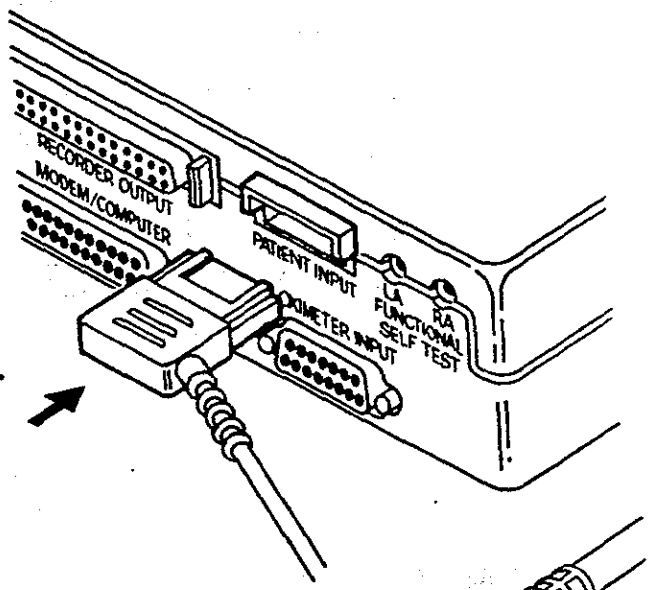
**WARNING: Once memory has been cleared, it is not possible to retrieve the data.**

**EXITING THE PARAMETERS DISPLAY MENU**

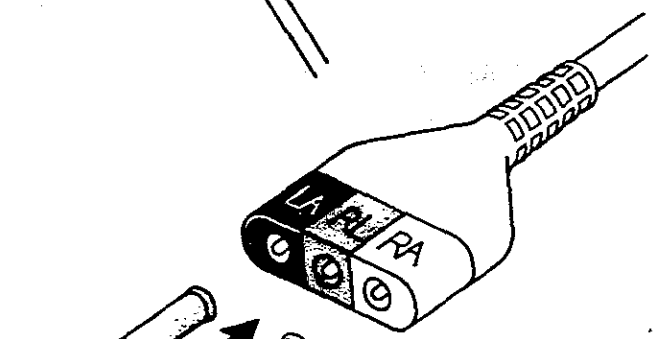
Each new value selected will be implemented when the SmartMonitor POWER is turned OFF (following the correct Power OFF sequence) and then turned ON. The only exceptions are Date, Time and Computer Phone Number which are changed immediately.

## CONNECTIONS: PATIENT CABLE, LEAD WIRES, ELECTRODES, CHARGER

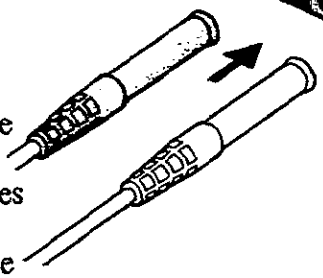
****WARNING:****
**Do not use non-safety lead wire and patient cable configurations with this monitor. Using the non-safety style lead wire and patient cable configurations may pose a risk of severe electrical shock or death. Verify that proper lead wire and patient cable connections occur. Use only Healthdyne safety lead wire and patient cable configurations with Healthdyne apnea monitors.**



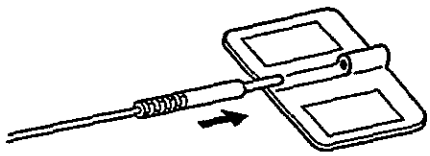

**Step 1. Connect the patient cable to the SmartMonitor.** One end of the patient cable has a metal plate on the top side. With the top side up, insert the cable into the connector on the back of the SmartMonitor marked "PATIENT INPUT" until you hear a soft "click."



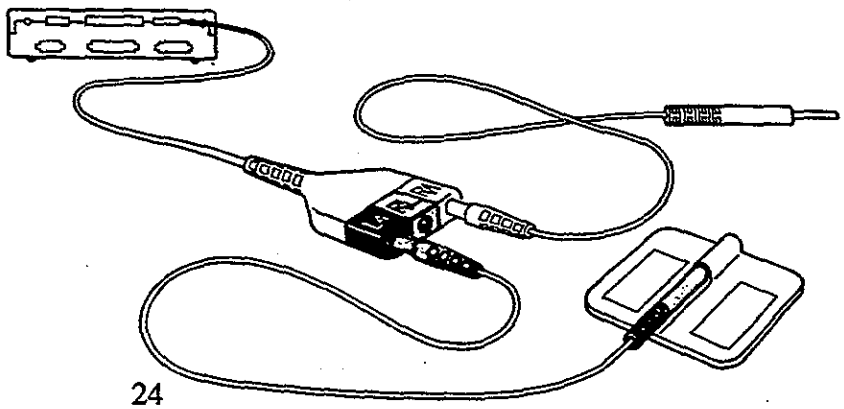

**Step 2. Connect the lead wires to the patient cable.** The larger end of the patient cable has three receptacles. Take the WHITE lead wire and insert it into the receptacle marked "RA." Take the BLACK lead wire and insert it into the receptacle marked "LA." Make sure the lead wires are fully inserted into the patient cable. (Firmly push the lead wires until the socket "snaps" into place.) To remove lead wires, grasp and pull at the strain relief area located near the connecting tip.



**NOTE:** Use of the third (Green/"RL") electrode and lead wire is normally not required, but may reduce electrical interference in "noisy" environments. Refer to Warnings and Cautions on page 58 for details.

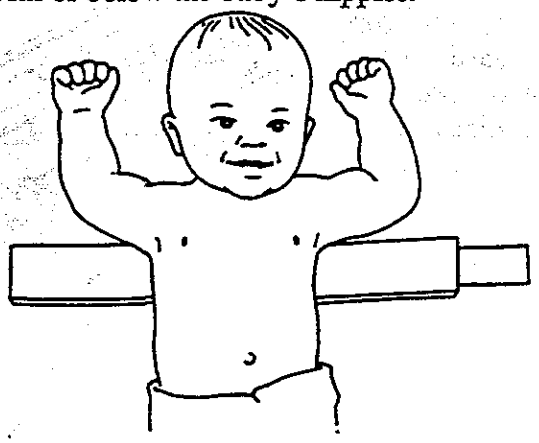


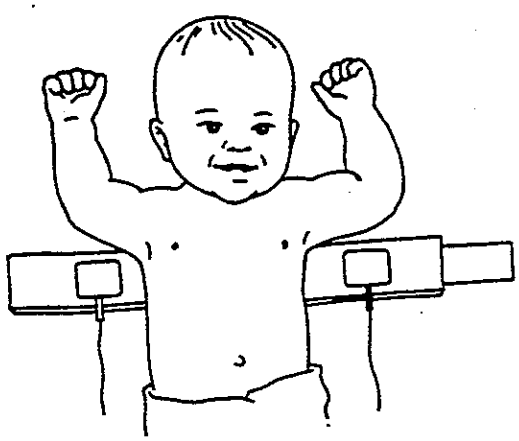
**Step 3. Connect the lead wires to the electrodes.** Insert a lead wire into the Velcro™-side of each electrode. Make sure the metal tips of the lead wires are fully inserted.



## INFANT/PEDIATRIC PLACEMENT

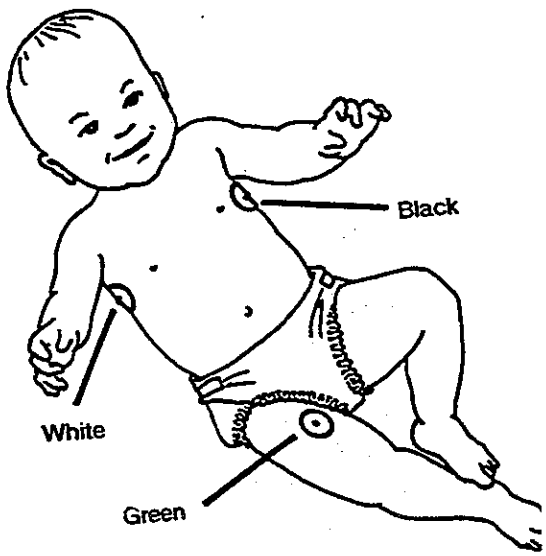
**Step 4.** Place the electrode belt on a flat surface. Place the baby's back on the belt so the top of the belt is aligned with or below the baby's nipples.

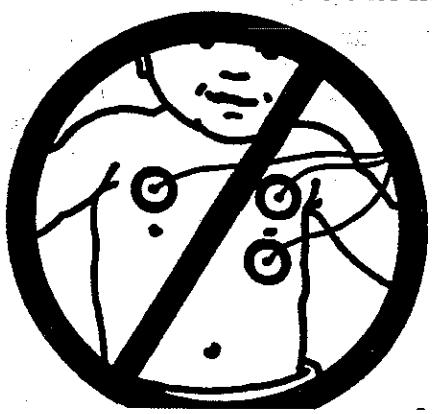




**Step 5. Place the electrodes on the belt.**
Place the electrodes, Velcro-side down, on the belt. The electrode with the WHITE lead wire should be on the baby's right side (not your right). The electrode with the BLACK lead wire should be on the baby's left side. Place the electrodes far enough apart so when the belt is wrapped around the baby one electrode will be located on each side of the chest (underneath the armpit, lined up with or below the nipples). This is a recommended "starting" position. Alternate electrode locations may be required for optimum respiratory detection. Refer to the Technical Note on page 29.

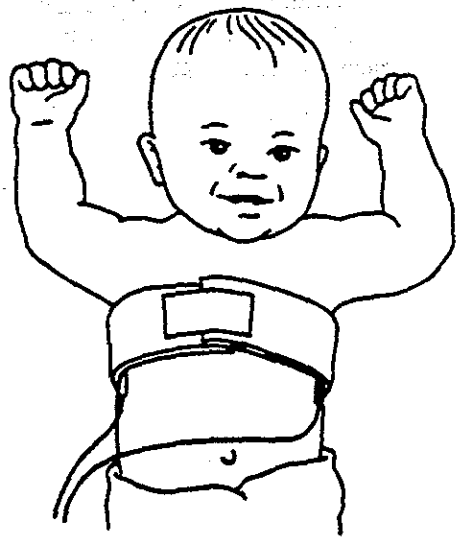
**NOTE:** In hospital applications, three disposable, "sticky" electrodes are typically used for short-term monitoring. Healthdyne recommends the use of reusable hydrogel electrodes Model 9510 or 9515. The electrode with the WHITE lead wire should be on the baby's right side (not your right). The electrode with the BLACK lead wire should be on the baby's left side. These electrodes should be placed under the armpits, just below the nipple line. The optional GREEN electrode and lead wire should be placed on the upper right thigh. The third electrode/lead wire may also be used if you experience excessive false alarms. This electrode will serve as a reference lead.



Incorrect

**Step 6. Wrap the electrode belt around the baby.**
Wrap the belt around the baby's chest and fasten it with the Velcro tab. It should be snug enough so that only two fingers can be inserted between the belt and the baby. With newborns and very small babies, you will have to shorten the belt by cutting off a small part.

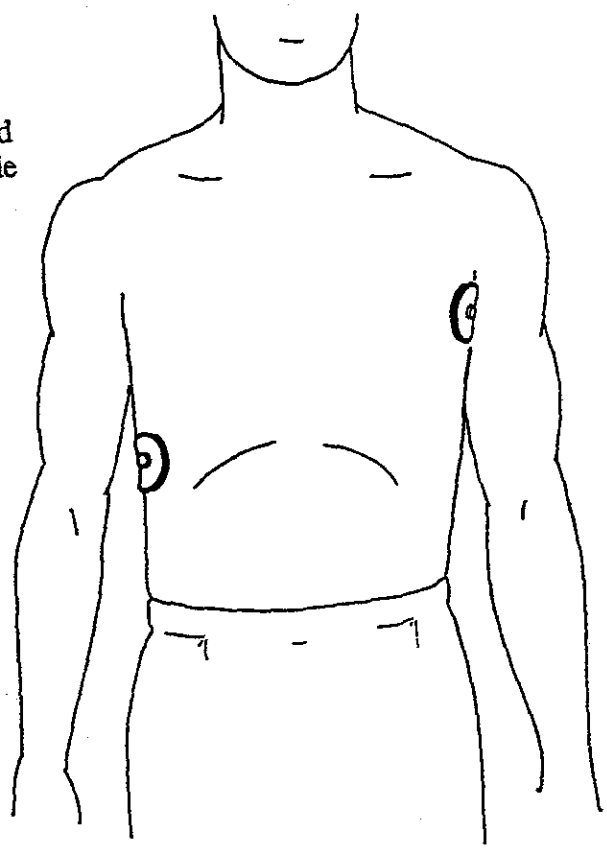


**NOTE: Steps 4-6 describe only one method for electrode placement and positioning. You may choose to show patients another method.**

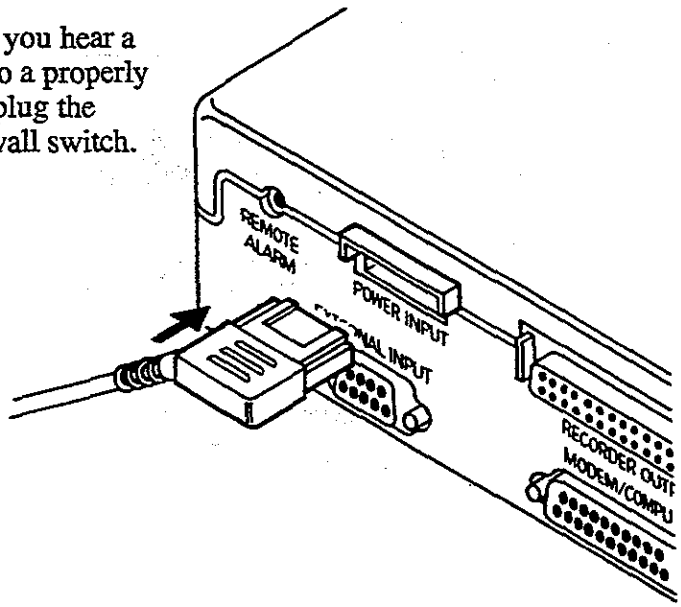
## ADULT PLACEMENT

When using disposable electrodes, recommended initial electrode positioning is under the left armpit, in line with the nipples; and under the right armpit, near the lower portion of the rib cage. The electrode with the BLACK lead wire should be under the left armpit in line with the nipples. The electrode with the WHITE lead wire should be under the right armpit near the lower portion of the rib cage.

**NOTE: Healthdyne provides clip-on lead wires, but has not yet approved any particular brand of disposable electrodes.**

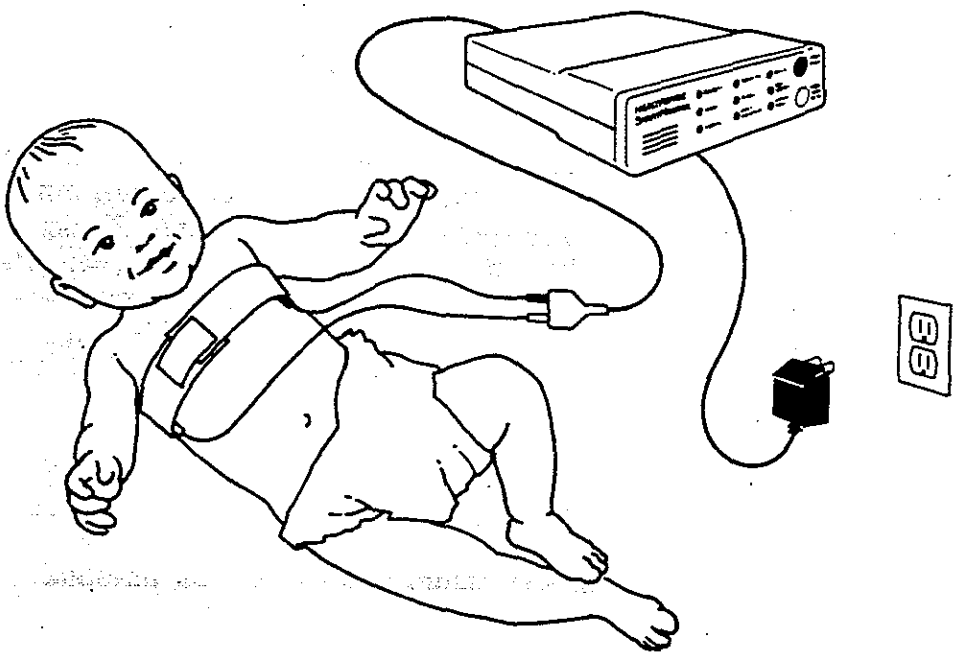


**Step 7. Connect the Battery Charger.**
Insert the flat connector end of the Battery Charger (metal side up) into the connector on the back of the SmartMonitor marked "POWER INPUT" until you hear a soft "click." Then plug the Battery Charger into a properly grounded three-pronged power outlet. Do not plug the Battery Charger into an outlet controlled by a wall switch.




**Step 8. Turn the SmartMonitor on.**
Push the POWER OFF/ON button. The lights on the front of the SmartMonitor and the audible alarm should come on briefly. This is a routine test of the audible alarm. After a ten-second delay, the green RESPIRATION and HEART lights should begin to flash (if you have attached the electrode belt properly and made complete connections).

**NOTE:** The green light marked RESPIRATION will blink with each breath movement that the SmartMonitor detects by measuring changes in chest impedance. The light should blink only once for each breath, although it may flash additional times when the patient is moving. Listen and watch the baby breathe. If this light flashes more or fewer times than the baby breathes, contact Healthdyne Technical Support immediately.



## PORTABLE USE

The SmartMonitor is easily adapted to portable operation. The steps you would normally take in setting up the SmartMonitor are the same ones to take for portable operation with one exception. The Battery Charger is not used during portable operation of the SmartMonitor; instead, the SmartMonitor will rely on the batteries for power. Make sure the batteries are fully charged before taking the SmartMonitor off the Battery Charger (24 hours should recharge fully depleted batteries, though less time is needed for partially drained batteries — for each hour the batteries are in operation, they should be recharged for at least 1 hour). When the batteries are fully charged, the SmartMonitor can be portably operated for approximately 24 hours (depending upon several factors such as number of alarms, etc.). However, Healthdyne recommends that the SmartMonitor be used with the Battery Charger whenever possible.

****CAUTION****

**It is important to make sure that the speaker on the SmartMonitor (located below the SmartMonitor logo) is never covered by anything that would muffle the sound of an alarm.**

## TECHNICAL NOTE

### Proper Electrode Placement Reduces False Alarms and Optimizes Respiratory Signal Amplitude

Impedance pneumography is a technique used by most home apnea monitor manufacturers to detect respiratory effort and to determine when to trigger the apnea alarm during central apnea. The base (resting) impedance of infants is typically 200-1,000 ohms. Typical changes in impedance during respiratory efforts can range from 0.3 to 3 ohms, dependant upon respiratory rate. The Healthdyne 900S, 900SL, 950S and 970S monitors all have a maximum sensitivity of about 0.15 ohms, dependant upon respiratory rate. This level was chosen to reduce the possibility of picking up artifact (electrical noise, movement) as valid breaths, thus preventing a false negative apnea alarm due to artifact detection.

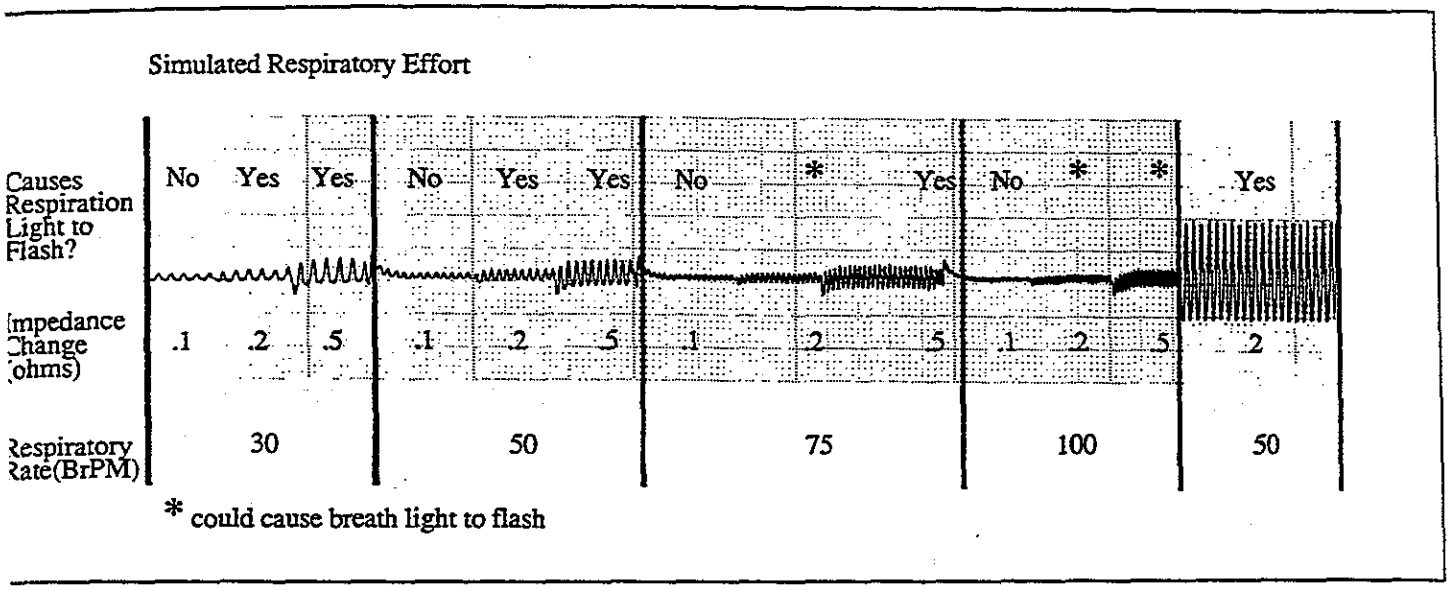
The respiration detection circuit uses a technique called Adaptive Threshold Control (ATC) to maintain optimal sensitivity as the respiratory signal amplitude changes. The ATC moves the sensitivity threshold to a level equivalent to 80 percent of the preceding respiratory amplitude. If the breathing effort stops, the ATC automatically adjusts the threshold downward to the maximum sensitivity.

Maximum sensitivity varies somewhat according to respiratory rate. The monitors are most sensitive at about 30 breaths per minute (BrPM), close to 0.15 ohm. At a respiratory rate of 100 BrPM, sensitivity is about 0.5 ohm, and at a respiratory rate of 150 BrPM, about 2 ohms. Thus respiratory effort at 30 BrPM must cause at least a 0.15 ohm change to trigger the breath light, but respiratory effort at 100 BrPM must cause at least a 0.5 ohm change to trigger the breath light. (An E-GRAM® Report segment illustrating simulated respiratory effort signals at various rates and impedance changes is located on the following page.)

Apnea alarms and low amplitude recordings which occur during the presence of low amplitude respiratory effort signals are normally caused by compromised electrode placement. This is not a new phenomena. It has been common with home apnea monitors, especially during the first couple of weeks when parents are learning to use the monitor.

To improve signal strength and reduce false alarms, the electrodes should be placed at the point of maximum respiratory effort movement. Usually, this is the upper chest area, but many infants may change from chest to abdominal movement during sleep or in a random fashion. If the electrode belt is placed on the chest, but the infant is moving the abdomen, low amplitude signals will be present at the electrodes on the chest. If the belt is moved downward (as low as the bottom of the rib cage), the abdominal movement is usually of sufficient amplitude to prevent apnea alarms. If the patient changes from abdominal to chest movement while the belt is low on the rib cage, low amplitude signals can again be present at the abdomen, which may result in apnea alarms and low amplitude recordings. The use of disposable electrodes eliminates the need for a belt, therefore the left electrode can be placed high, and the right electrode can be placed low to attempt to detect both chest and abdomen effort.

Experimentation with electrode positioning is required to determine positioning which optimizes respiratory signal amplitude and which minimizes false positive apnea alarms. Clean electrodes, clean skin and a snug belt all improve respiratory signal detection and minimize false positive apnea alarms. It is also very important to use only Healthdyne-supplied or approved electrodes, lead wires and patient cables for optimum monitoring performance.


Simulated Respiratory Effort
Causes Respiration Light to Flash?
No Yes Yes No Yes Yes No * Yes No * * Yes
Impedance Change (ohms)
.1 .2 .5 .1 .2 .5 1 2 5 1 2 5 2
Respiratory Rate(BrPM)
30 50 75 100 50
* could cause breath light to flash

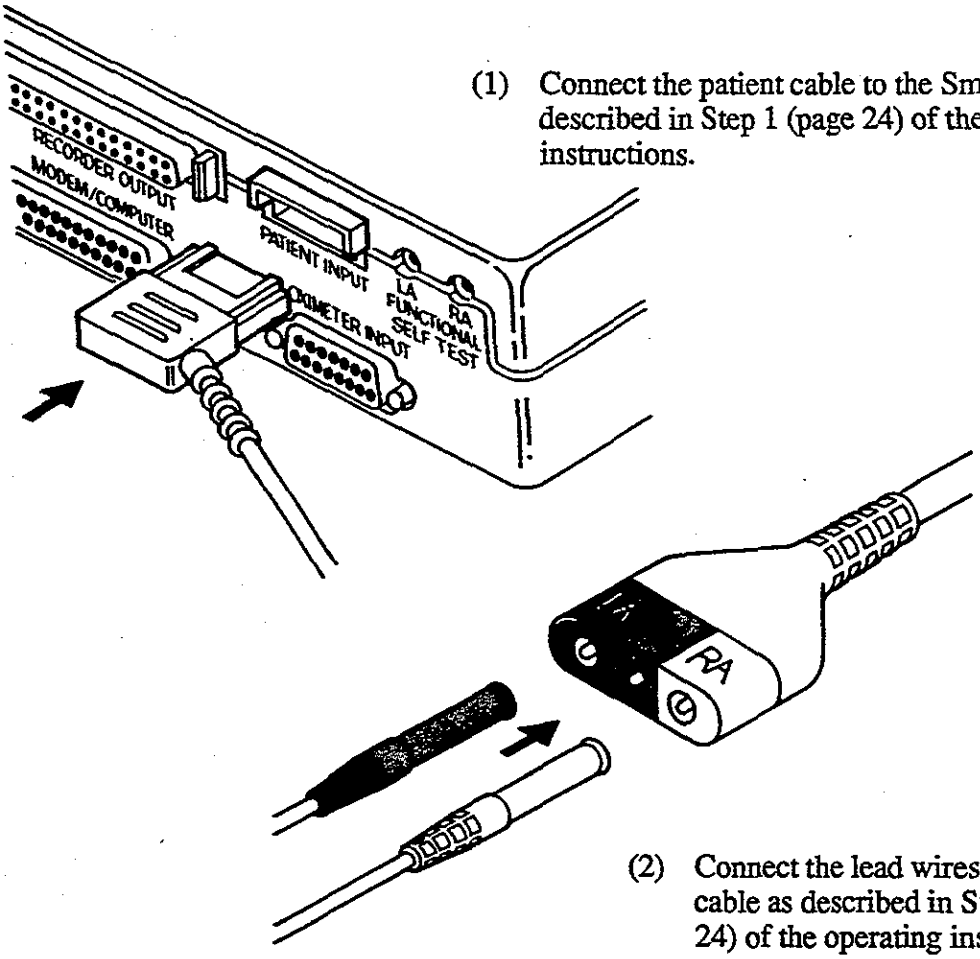
This E-GRAM® Report segment illustrates simulated respiratory effort signals at various rates and impedance changes (amplitudes). The base impedance is 100 ohms, and the print speed is 1 mm/sec. Compare these waveforms to patient waveforms from E-GRAM Reports which were triggered by the apnea alarm (or apnea for record). You can determine whether the respiratory signal from the patient was strong enough to cross the sensitivity threshold, thus causing the respiration light to flash. The "No" samples above represent signals which usually result in false positive apnea alarms.

This Technical Note is reprinted (with minor revisions) from the ***TrendLines*** newsletter, Volume 1, Issue 4, October 1991; published by Healthdyne Technologies.

## FUNCTIONAL SELF-TEST

**The Functional Self-Test should be done at least once a week, as well as under the following conditions:**

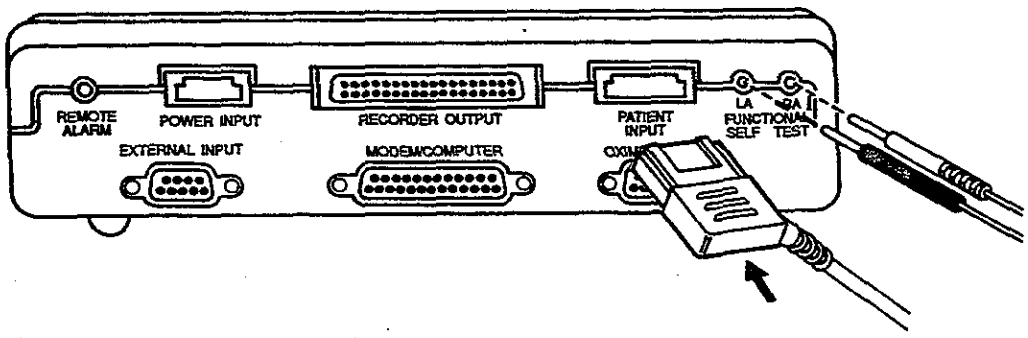
1. When a lead wire is changed.
2. When the patient cable is changed.



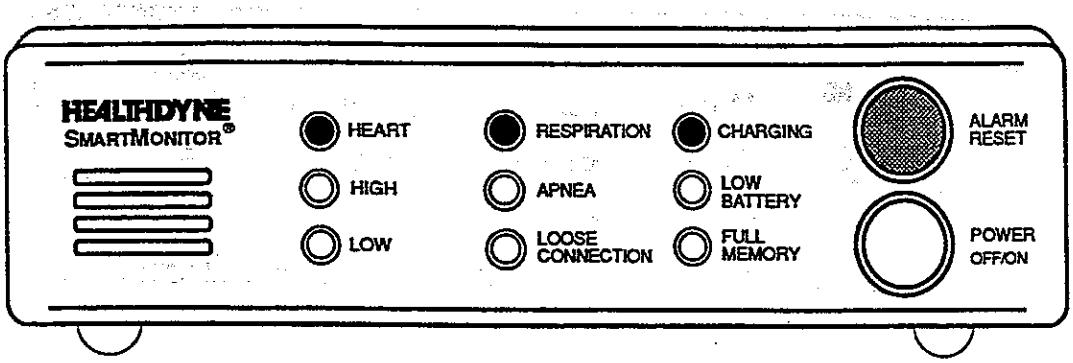

(1) Connect the patient cable to the SmartMonitor as described in Step 1 (page 24) of the operating instructions.

(2) Connect the lead wires to the patient cable as described in Step 2 (page 24) of the operating instructions.

(3) Connect the lead wires to the SmartMonitor back panel FUNCTIONAL SELF-TEST output. Insert the WHITE lead wire into the receptacle labeled "RA." Insert the BLACK lead wire into the receptacle labeled "LA."



(4) Press the POWER OFF/ON button to turn the SmartMonitor on. The SmartMonitor's alarm should make a short "beep" and the lights on the front of the SmartMonitor should come on for approximately two seconds. After all the alarm lights turn off, the CHARGING light should remain on and the green HEART and RESPIRATION lights should be blinking.




**NOTE:** A built-in ECG/Respiration simulator with preset rates and amplitudes provides the signals used during the Functional Self-Test.

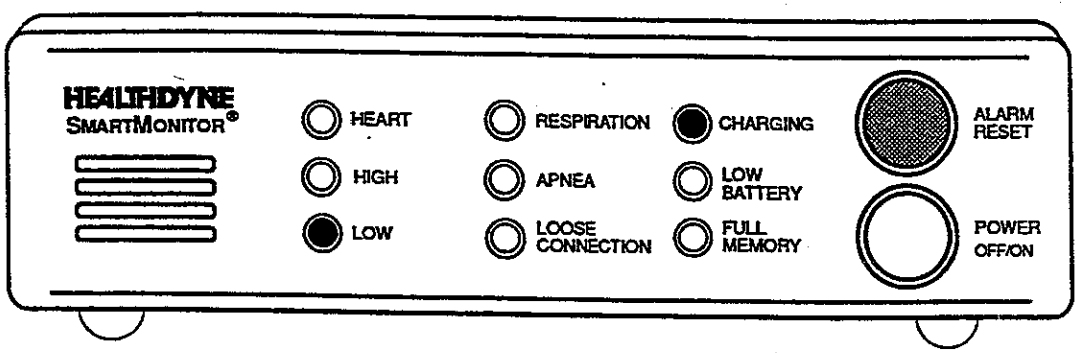
**If the following lights remain on or are blinking, and/or the alarm sounds continuously, corrective action should be taken before continuing the Functional Self-Test. Start the test over once the problem has been corrected.**

A. **LOW BATTERY** - The SmartMonitor battery pack is discharged. Turn the SmartMonitor off using the correct Power Off procedure described previously. Make sure the Battery Charger is plugged into a live power outlet and properly connected to the SmartMonitor. Allow the SmartMonitor to recharge for 24 hours before performing the Checkout Procedure.

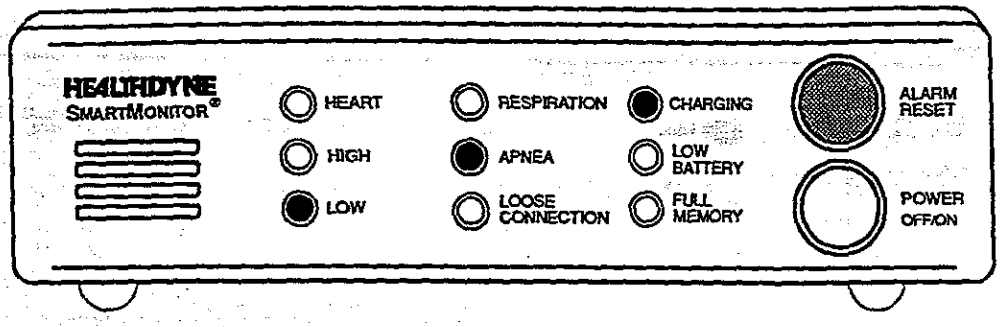
B. **FULL MEMORY** (900SL, 950S, and 970S only) - The SmartMonitor's memory is 80% to 100% full. If the SmartMonitor has been used on patients, the memory should be transferred to a Memory Disk, then cleared using the procedure described in the 9500 Operator's Manual.

C. **LOOSE CONNECTION** - Indicates loose or bad lead wires or patient cable. Check all connections and/or replace lead wires first, then the patient cable if necessary. Refer to page 5 for details.

(5) After approximately 30 seconds, the green HEART and RESPIRATION lights should stop blinking. The red LOW light should illuminate within approximately seven seconds after the HEART light stops flashing, and the audible alarm should beep once every second.



(6) The next light to illuminate should be the red APNEA light. Both the LOW HEART and APNEA lights will be on. (There should be no green HEART or RESPIRATION light flashes during this alarm.) The delay before activation of the APNEA light depends upon the setting of the APNEA ALARM parameter.




(7) Remove one lead wire from the FUNCTIONAL SELF-TEST output. To remove lead wires, grasp and pull at the strain relief area located near the connecting tip. Do not grasp the wire. The LOOSE CONNECTION light will come on, and the sound will change from beeping to continuous. When it does, the SmartMonitor, patient cable, and lead wires are working as they should.

(8) Turn the SmartMonitor off using the correct Power-Off procedure:

- Press and **hold** the blue ALARM RESET button.
- Press and release the white POWER OFF/ON button.
- Wait two seconds, then release the ALARM RESET button.

If the SmartMonitor is not powered off correctly, the alarm will sound continuously. This is the "sibling" alarm. To correct a "sibling" alarm, press the POWER OFF/ON button to ON. Press and hold the ALARM RESET button, then press and release the POWER OFF/ON button. Wait two seconds, then release the ALARM RESET button. Repeat the proper Power-Off procedure as described above (Step 8).

****CAUTION****

The SmartMonitor's lights and alarms should behave as described in the Self-Test. If they don't, contact Healthdyne Product Support. The Functional Self-Test is the easiest way to check the lead wires and the patient cable. Do not use the monitor if the audible alarm sounds weak or does not activate upon initial power-on. Also, you can determine the loudness and response of the alarm during the performance of the Functional Self-Test feature (page 32). Should the alarm sound weak or fail to activate, contact Healthdyne Product Support for assistance.

# VII. USING THE PHONE MODEM

## Using the Practical Peripherals Model 2400V Phone Modem

### HOME SETUP

A Model 2400V Phone Modem is available for use with the SmartMonitor. The Modem allows the dealer or hospital to communicate with the SmartMonitor through the telephone lines.

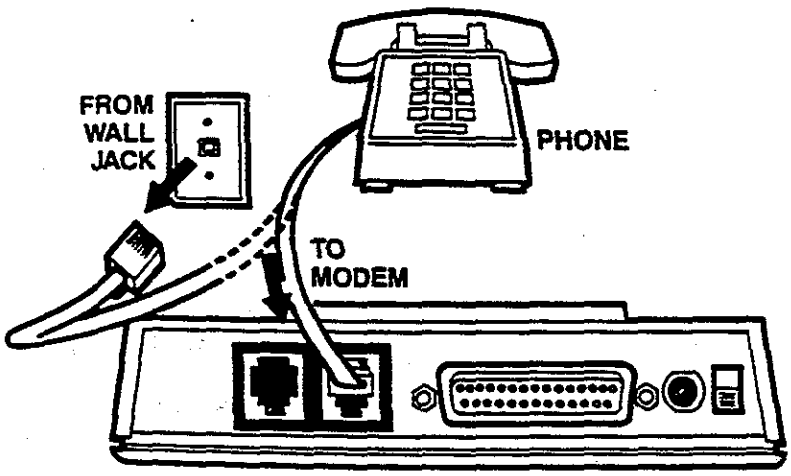
Using a Series 9500 Computer, the dealer or hospital can communicate with the SmartMonitor in the following ways:

- Check the alarm and recording limits to make sure each one is set properly.
- If necessary, change the alarm or recording limits.
- Review the Patient and Equipment Event Logs to determine what types of alarms have occurred.
- Look at the patient signals from your SmartMonitor to find what caused the alarms to occur.

The dealer or hospital must contact the parent when it is time to work with the SmartMonitor through the Modem. It is easy to prepare the SmartMonitor, Modems, computer and telephones to work together. Follow the steps below and make sure that each one is completed.

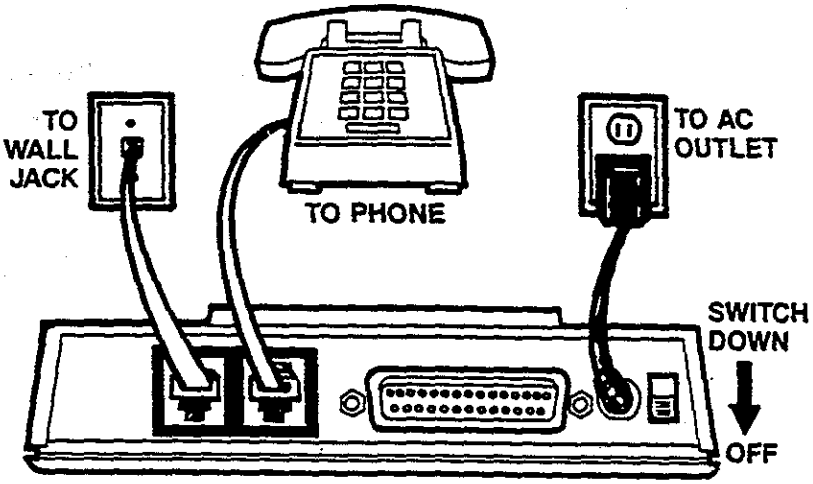
**NOTE:** The 2400V Modem works only with Type 02 or later SmartMonitors. Type 02 and later SmartMonitors must be programmed to match the 2400V Modem.

**Step 1.** Unplug the telephone from the wall. Plug the telephone wire into one of the two phone connectors (the two identical openings placed side-by-side) on the back of the Modem.




**Step 2.** Connect a Model 9155 or 9160 Cable between the phone connector of the Modem and the wall jack. The cable ends are the same, either end can be plugged into the Modem or wall jack.

**Step 3.** Connect the Modem Power Supply to the wall outlet and the Modem.



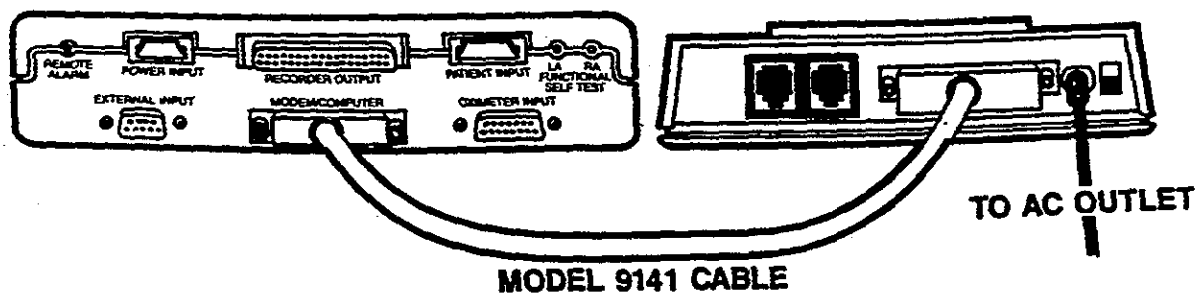

**Step 4.** Slide the switch on the rear of the Modem downward to off.

**Step 5.** Pick up the telephone and listen for a dial tone. If you do not hear a dial tone, check all cables to make sure each one is plugged in completely. Also, make sure the Modem power switch is downward to off.

If you still do not hear a dial tone, disconnect the Modem from the wall jack. Then connect the telephone to the wall jack. Call Healthdyne for assistance.

**Step 6.** When you hear a dial tone, hang up the telephone. You can use the telephone to call out. You can receive calls as usual as long as the Modem power switch is in the downward (off) position.

**Step 7.** Connect the SmartMonitor to the Modem using a Model 9141 Cable. Either end of the cable may be plugged into the Modem. The 9141 Cable should be secured to the Modem using the screws on the cable connector.



**Step 8.** The SmartMonitor must be programmed to match the modem. To specify the Modem, remove the SmartMonitor display cover with a screwdriver. Then follow the steps below.

(a) Press the POWER OFF/ON button to ON. The display should read: MENU MODE? ENTER PROPER KEY SEQUENCE.

(b) Then press the keys in the following sequence within 10 seconds: PRIOR, NEXT, NEXT, ENTER, ENTER, ENTER.

The display should read one of the messages below:

"STD ALARM PARAMETERS ARE SELECTED"
or
"STD ALARM PARAMETER NOT SELECTED"

(c) Press PRIOR until the message displays the following:

MODEM-CABLE
2400V/9600VO-9141

(d) The default setting is "2400V/9600VO-9141" as shown above. To change the SmartMonitor for use with a 2400V Modem:

- Press the ENTER key. The display will flash the current selection.
- Press the NEXT key as required to change the display to "2400V/9600V-9141".
- Press the ENTER key to implement the change.

(e) Exit the Parameters Display Menu. Turn the SmartMonitor power off:

- Press and hold the blue ALARM RESET button.
- Press and release the white POWER OFF/ON button.
- Wait two seconds, then release the ALARM RESET button.

**Step 9.** To allow the SmartMonitor to work with the Modem, activate the Communications Mode of the SmartMonitor.

- Press and hold the ALARM RESET button.
- Push the POWER OFF/ON button to ON.
- Wait until the monitor alarms. Release the ALARM RESET button then briefly press and release the ALARM RESET button. The alarm sound will stop.

**If the FULL MEMORY light is on, press the ALARM RESET button again to silence the alarm.**

The SmartMonitor beeps every 10 seconds whenever the SmartMonitor is in the Communications Mode, but not "connected" or linked to the computer. This is a reminder that the SmartMonitor is powered on for working with the Modem, but not to monitor the infant.

**NOTE:** When the SmartMonitor is in the Communications Mode, the bottom panel display reads: "COMM MODE SELECTED." Be sure to tell parents to look at the bottom panel to verify that they see this message. If they do *not* see this message, they should repeat Step 9.

****WARNING****

Do not connect the infant to the SmartMonitor if you prepared the SmartMonitor to work with the Modem in the Communications Mode (Step 9). The Apnea and Heart Rate alarms do not work when the SmartMonitor is set up (in the Communications Mode) for use with the Modem.

**Step 10.** Instruct the parent when to switch the Modem power to the ON (upward) position. The lights on the front of the Modem will turn on. It is not important to determine which lights are on or off.

**Step 11.** After about one minute, call the home phone number using a modem in the computer. Whether the phone rings or not, the Modem will answer the call and connect the SmartMonitor to the computer through the phone line. **The OH and CD lights on the front of the Modem will turn on showing that a communications link has been established.**

**Step 12.** The amount of time required to work with the SmartMonitor will not always be the same. It could be as short as a few minutes, or as long as 30 minutes. When information is retrieved from the SmartMonitor (and you have finished working with the SmartMonitor), it will beep five times.

NOTE: Refer to the 9500SE/9500SG Computer System Operator's Manual for detailed instructions regarding modem communications with the SmartMonitor.

In a few seconds, the OH and CD lights on the Modem will turn off. This signals that the communications link is no longer set up. **Switch the Modem power back to the OFF (downward) position.** The phone may now be used.

## MODEM COMMUNICATIONS SCRIPT

The following sample script may help simplify the process of transferring data using the phone modem.

**Typical questions from dealer/nurse to parent:**

- Are you monitoring the baby?
- Can we talk to the SmartMonitor for the next 3 to 30 minutes? (The time will depend upon how much information is in the SmartMonitor and how much information will be selected for transfer.)
- Is the SmartMonitor connected to the Modem?
- Is the SmartMonitor prepared for communications (Comm mode)?
- Is the SmartMonitor beeping once every 10 seconds?
- Is the Modem connected to the phone line? Power supply?

**Typical instructions from dealer/nurse to parent:**

- After we finish talking, hang up the phone and then change the power switch on the rear of the Modem ON (upward). This is so the information transfer process can be started.
- Do not answer the phone if it rings shortly after you hang up.
- Please warn family members not to pick up the phone (or extensions) during data transfer.
- When you hear the SmartMonitor beep five times, watch for the Modem OH and CD lights to turn off. Then change the power switch on the rear of the Modem back to OFF (downward).
- If you need to make an emergency phone call during transmission, change the Modem power switch back to "OFF.". Call me after the emergency and let me know when you can continue the data transfer process.

## TIPS FOR USING THE 2400V PHONE MODEM

### Emergency Phone Calls

If the parent(s) need to make an emergency phone call during the time the Modem power switch is in the ON position, follow the steps below:

(1) Switch the Modem power to the OFF position.
(2) Pick up the telephone and listen for a dial tone.
(3) Dial out normally.

If there is no dial tone, hang up, wait five seconds, and then try again.

### Connections

Once the Modem and telephone are set up, the connections may be left set up for convenience. The telephone will work normally as long as the Modem power switch is in the OFF position.

The telephone may also be moved to another phone jack if desired. The telephone does not have to be connected to the Modem during SmartMonitor communications.

### Incoming Phone Calls

The Modem answers incoming calls only when the power switch is in the ON position. If the parent(s) do not change the power switch back to the OFF position, incoming voice calls cannot be received.

### Call Waiting/Call Forwarding

Call waiting and call forwarding interrupt Modem communications. Healthdyne strongly recommends suspension of call waiting and call forwarding services as long as Modem Communications are planned.

**NOTE:** If call waiting or call forwarding interrupts the modem and communications, 30 to 60 seconds of time will be required before the 9500 software recognizes and alerts the computer operator of the disconnection.

### Multiple Phones

If a phone in a different room is picked up during Modem communications, electronic sounds can be heard. This can interfere with communications and may cause termination of the communications connection.

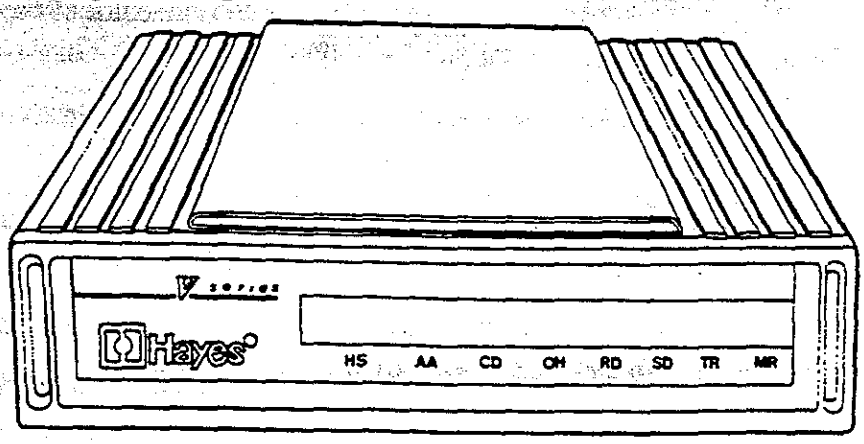
### Party Lines

Use of a Modem in a home with a party line is not recommended due to the probability of communications interference.

# Using the Hayes Model 2400V and 9600VO/9600V Phone Modem

## HOME SETUP

The Hayes Model 2400V and 9600VO/9600V Phone Modems are available for use with the SmartMonitor. The Modem allows the dealer or hospital to communicate with the SmartMonitor through the telephone lines.



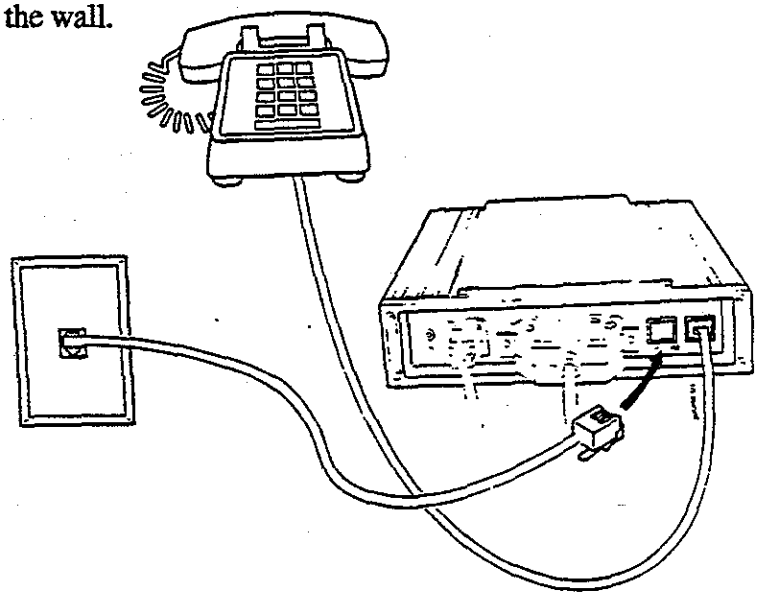

Using a Series 9500 Computer, the dealer or hospital can communicate with the SmartMonitor in the following ways:

- Check the alarm and recording limits to make sure each one is set properly.
- If necessary, change the alarm or recording limits.
- Review the Patient and Equipment Events Logs to determine what types of alarms have occurred.
- Look at the patient signals from your SmartMonitor to find what caused the alarms to occur.

The dealer or hospital must contact the parent when it is time to work with the SmartMonitor through the Modem. It is easy to prepare the SmartMonitor, Modems, computer and telephones to work together. Follow the steps below and make sure that each one is completed.

**NOTE:** The 9600V Modem works only with Type 02 or later SmartMonitors.

**Step 1.** Unplug the telephone from the wall. Plug the telephone wire into the TO PHONE connectors on the back of the Modem.



**Step 2.** Connect the Modem Power Supply to the wall outlet and to the Modem connector marked 14.VAC (or 9.0 V~AC).

**Step 3.** Set the power switch on the rear of the Modem downward to "0." This will turn it off.

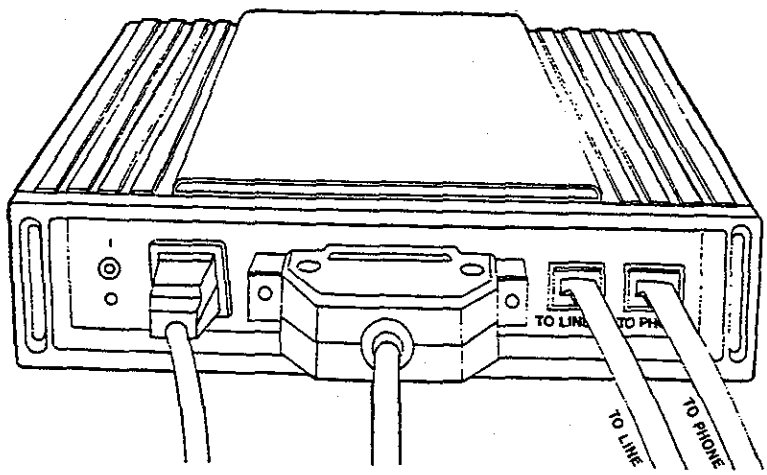
**Step 4.** Connect a Model 9155 or 9160 Cable between the LINE connector of the Modem and the wall jack. The cable ends are the same — either end can be plugged into the Modem or wall jack.

**Step 5.** Pick up the telephone and listen for a dial tone. If you do not hear a dial tone, check all cables to make sure each one is plugged in completely. Also, make sure the Modem power switch is set downward to off.

If you still do not hear a dial tone, disconnect the Modem from the wall jack. Then connect the telephone to the wall jack. Call Healthdyne for assistance.

**Step 6.** When you hear a dial tone, hang up the telephone. You can use the telephone to call out. You can receive calls as usual as long as the Modem power switch is in the downward (off) position.

**Step 7.** Connect the SmartMonitor to the Modem using a Model 9141 Cable. Either end of the cable may be plugged into the Modem connector marked DTE INTERFACE. The 9141 Cable should be secured to the Modem using the screws on the cable connector.



**Step 8.** The SmartMonitor must be programmed to match the 9600V Modem. To specify the Modem, remove the SmartMonitor display cover with a screwdriver. Then follow the steps below:

(a) Press the POWER OFF/ON button to ON. The display should read: MENU MODE? ENTER PROPER KEY SEQUENCE.

(b) Then press the keys in the following sequence within 10 seconds: PRIOR, NEXT, NEXT, ENTER, ENTER, ENTER.

The display should read one of the messages below:

"STD ALARM PARAMETERS ARE SELECTED"
or
"STD ALARM PARAMETERS NOT SELECTED"

(c) Press PRIOR until the message displays the following:

MODEM-CABLE
2400V/9600VO-9141

(d) The default setting is "2400V9600VO-9141" as shown above. To change the SmartMonitor for use with the Hayes Modem:

- Press the ENTER key. The display will flash the current selection.
- Press the NEXT key as required to change the display to "2400V/9600VO-9141".
- Press the ENTER key to implement the change.

(e) Exit the Parameters Display Menu. Turn the SmartMonitor power off:

- Press and hold the blue ALARM RESET button.
- Press and release the white POWER OFF/ON button.
- Wait two seconds, then release the ALARM RESET button.

**Step 9.** To allow the SmartMonitor to work with the Modem, activate the Communications Mode of the SmartMonitor:

- Press and hold the ALARM RESET button.
- Push the POWER OFF/ON button to ON.
- Wait until the monitor alarms. Release the ALARM RESET button and briefly press and release the ALARM RESET button.

**If the FULL MEMORY light is on, press the ALARM RESET button again to silence the alarm.**

The SmartMonitor beeps every 10 seconds whenever the SmartMonitor is in the Communications Mode, but not "connected" or linked to the computer. This is a reminder that the SmartMonitor is powered on for working with the Modem, but not to monitor the infant.

**NOTE:** When the SmartMonitor is in the Communications Mode, the bottom panel display reads: "COMM MODE SELECTED." Be sure to tell parents to look at the bottom panel to verify that they see this message. If they do *not* see this message, they should repeat Step 9.

****WARNING****

**Do not connect the infant to the SmartMonitor if you prepared the SmartMonitor to work with the Modem in the Communications Mode (Step 9). The Apnea and Heart rate alarms do not work when the SmartMonitor is set up (in the Communications Mode) for use with the Modem.**

**Step 10.** Instruct the parent to switch the Modem power on to the "1" (upward) position. The lights on the front of the Modem will turn on. It is not important to determine which lights are on or off.

**Step 11.** After about one minute, call the home phone number using a modem in the computer. Whether the phone rings or not, the modem will answer the call and connect the SmartMonitor to the computer through the phone line. The OH and CD lights on the front of the Modem will turn on showing that a communications link has been established.

**Step 12.** The amount of time required to work with the SmartMonitor will not always be the same. It could be as short as a few minutes, or as long as 25 minutes. When information is retrieved from the SmartMonitor (and you have finished working with the SmartMonitor), it will beep five times.

In a few seconds, the OH and CD lights on the Modem will turn off. This signals that the communications link is no longer set up. **The parent(s) should then switch the Modem power off to the "0" (downward) position.** The phone may now be used.

## MODEM COMMUNICATIONS SCRIPT

The following sample script may help simplify the process of transferring data using the phone modem.

**Typical questions from dealer/nurse to parent:**

- Are you monitoring the baby?
- Can we talk to the SmartMonitor for the next 3 to 25 minutes? (The time will depend upon how much information is in the SmartMonitor and how much information will be selected for transfer.)
- Is the SmartMonitor connected to the Modem?
- Is the SmartMonitor prepared for communications (Comm mode)?
- Is the SmartMonitor beeping once every 10 to 30 seconds?
- Is the Modem connected to the phone line? Power supply?

**Typical instructions from dealer/nurse to parent:**

- After we finish talking, hang up the phone and then change the power switch on the rear of the Modem to "1" (upward). This is so the information transfer process can be started.
- Do not answer the phone if it rings shortly after you hang up.
- Please warn family members not to pick up the phone (or extensions) during data transfer.
- When you hear the SmartMonitor beep five times, watch for the Modem OH and CD lights to turn off. Then change the switch on the rear of the Modem off to "0" (downward).
- If you need to make an emergency phone call during transmission, change the Modem switch back to "0." Call me after the emergency and let me know when you can continue the data transfer process.

## TIPS FOR USING THE HAYES 2400V and 9600VO/9600V PHONE MODEMS

### Emergency Phone Calls

If the parent(s) need to make an emergency phone call during the time the Modem switch is in the "1" (ON) position, follow the steps below:

(1) Switch the Modem power to the "0" (OFF) position.
(2) Pick up the telephone and listen for a dial tone.
(3) Dial out normally.

If there is no dial tone, hang up, wait five seconds, and then try again.

### Connections

Once the Modem and telephone are set up, the connections may be left set up for convenience. The telephone will work normally as long as the Modem power switch is in the "0" (OFF) position.

The telephone may also be moved to another phone jack if desired. The telephone does not have to be connected to the Modem during SmartMonitor communications.

### Incoming Phone Calls

The Modem answers incoming calls only when the power switch is in the "1" (ON) position. If the parent(s) do not change the power switch back to the "0" (OFF) position, incoming voice calls cannot be received.

### Call Waiting/Call Forwarding

Call waiting and call forwarding interrupt Modem communications. Healthdyne strongly recommends suspension of call waiting and call forwarding services as long as Modem Communications are planned.

**NOTE:** If call waiting or call forwarding interrupt the modem and communications, 30 to 60 seconds of time will be required before the 9500 software recognizes and alerts the computer operator of the disconnection.

### Multiple Phones

If a phone in a different room is picked up during Modem communications, electronic sounds can be heard. This can interfere with communications and may cause termination of the communications connection.

### Party Lines

Use of a Modem in a home with a party line is not recommended due to the probability of communications interference.

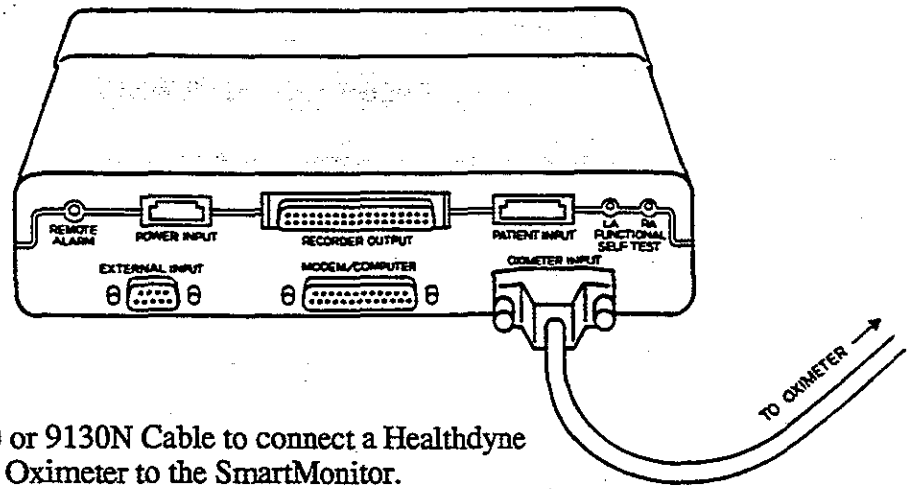
# VIII. USING AN OXIMETER

Oxygen saturation and pulse data can be recorded by connecting an Oximeter to the SmartMonitor. Follow the directions listed below:

**Step 1.** Place the Oximeter on a flat surface and place the SmartMonitor near the Oximeter.

**Step 2.** Channels 3 and 4 of the SmartMonitor must be programmed to accept oximetry data. Set Channel 3 Record to PULSE, and Channel 4 to SpO2. Refer to pages 19-20 for details.

**Step 3.** Connect a cable from the output of the Oximeter to the OXIMETER INPUT connector (SmartMonitor back panel).




- Use a 9130 or 9130N Cable to connect a Healthdyne Model 930 Oximeter to the SmartMonitor.
- The 9130 Cable allows oximeter alarms to trigger waveform events in the SmartMonitor and is recommended only when monitoring is closely supervised. The 9130N Cable does not allow waveform triggering, but does allow the SmartMonitor to record the SpO2 and Pulse signals from the oximeter during SmartMonitor patient alarms. The 9130N Cable is recommended for most home monitoring.
- When the Healthdyne 930 Oximeter is used, the SmartMonitor will record Oximeter power on/off (usage compliance) in the Equipment Events Log
- A Nellcor, Ohmeda, or similar oximeter requires a 9132 Cable. Oximeter alarms using a 9132 Cable will not allow waveform event triggering in the SmartMonitor.

  1. Connect the SpO2 plug to the SATURATION connector of the oximeter.
  2. Connect the PULSE/PULSE RATE plug to the PULSE or PULSE RATE connector of the oximeter (physician 's preference, but PULSE is recommended) .

- Plug adapters provided with the 9132 Cable are needed for the Nellcor or compatible oximeter only.
- Healthdyne will provide a cable for most other oximeters.
- Use the Operator's Manual for the Oximeter for instructions on Oximeter setup and use.

****CAUTION****

- **Always remember to connect the cable from the Oximeter to the SmartMonitor before using the Oximeter.**
- **Oximetry data will not be recorded if Channel 3 Record and Channel 4 Record parameters in the SmartMonitor are not programmed correctly.**

# IX. USING THE MODEL 9175 BODY POSITION SENSOR

The 9175 Body Position Sensor can be used with the SmartMonitor to document infant body position. When used with the Model 970S SmartMonitor prone or supine position can be documented on each E-GRAM Report.

The 9175 Position Sensor includes Velcro hook material for attachment to a Velcro electrode belt wrapped around the infant's chest. If a Velcro belt is not used, the Velcro hook material on the sensor housing should be covered with skin-compatible tape., then the sensor housing can be attached to the patient using the skin compatible tape.

Before attaching the sensor, you must first prepare the SmartMonitor for recording.

**Step 1.** Press the POWER/OFF/ON button to ON. The display should read:

MENU MODE? ENTER PROPE KEY SEQUENCE.

**Step 2.** Then press the keys in the following sequence within 10 seconds:

PRIOR, NEXT, NEXT, ENTER, ENTER, ENTER.

Step 3. The display should read one of the messages below:

"STD ALARM PARAMETERS ARE SELECTED" or
"STD ALARM PARAMETERS ARE NOT SELECTED"

Step 4. Press the PRIOR key until the following message is displayed:

EXTERNAL ALARM
xxxx

Set this parameter to HIGH (prone position documentation). See the section on "Documentation" on page 3 of the Body Position Sensor *Professional Instructions for Use* (577-9175-20). To change the setting to HIGH, follow these steps:

- Press the ENTER key. The display will flash the current selection.
- Press the NEXT key as required to change the display to HIGH.
- Press the ENTER key to implement the change.

**Step 5.** Press the PRIOR key to display the following message:

EXTERNAL ALARM
xxx

Verify that this parameter is set to OFF. OFF is the default value for this setting.

Step 6. Turn the SmartMonitor power off:

- Press and hold the blue ALARM RESET button.
- Press and release the POWER OFF/ON button.
- Wait two seconds, then release the ALARM RESET button.

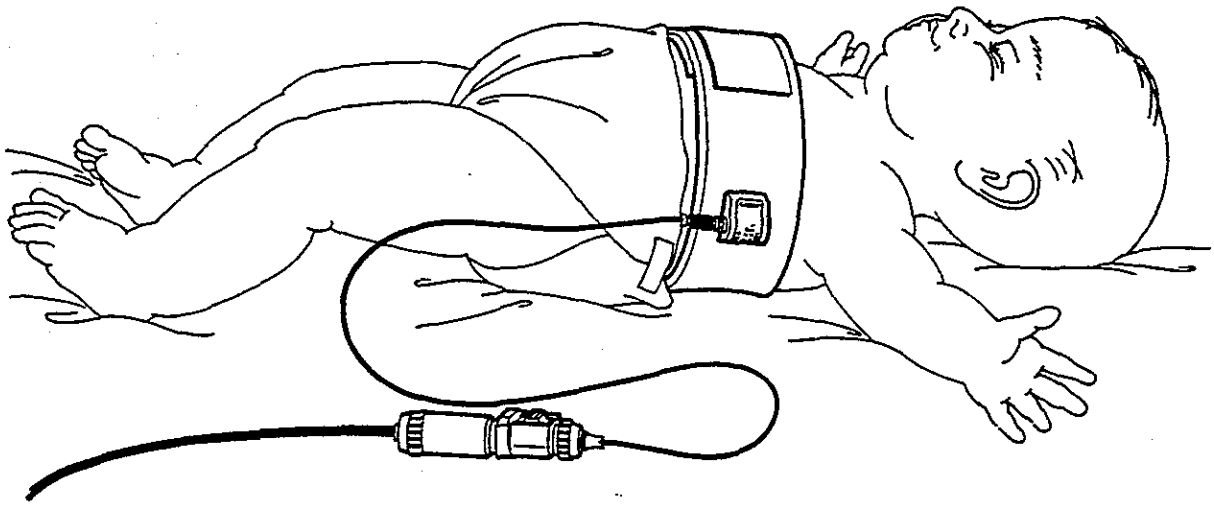
Connect the sensor.

**Step 1.** Insert the connector end of the Body Position Sensor into the 9175-2 or 9175-2E Connecting Cable. When the cables are properly connected, you should hear a soft click.

**Step 2.** Plug the 9175-2 or 9175-2E Connecting Cable into the EXTERNAL INPUT connector on the back of the SmartMonitor.

You are now ready to place the sensor on the infant.

Attach the Body Position Sensor to the outside of the electrode belt on the infant's left side. The cable should be exiting toward the baby's feet. If you are not using a Velcro electrode belt, cover the Velcro hook material on the sensor housing with skin-compatible tape. Apply the sensor to the infant's left side and secure the sensor with one or two strips of skin-compatible tape.



Refer to the *Professional Instructions for Use* (577-9175-20) for more detailed instructions, as well as for other information on the 9175 Body Position Sensor.

**NOTE:** A 9175-2 or 9175-2E Connecting Cable must be used with Type 02 and earlier SmartMonitors. Prone position is documented when EXTERNAL ALARM 2 is set to HIGH. Date, time, and duration of the prone position are documented in the Equipment Events Log.

**CAUTION:** Do not use a Model 9175-4 or 9175-4E Connecting Cable on a Type 02 or earlier SmartMonitor.

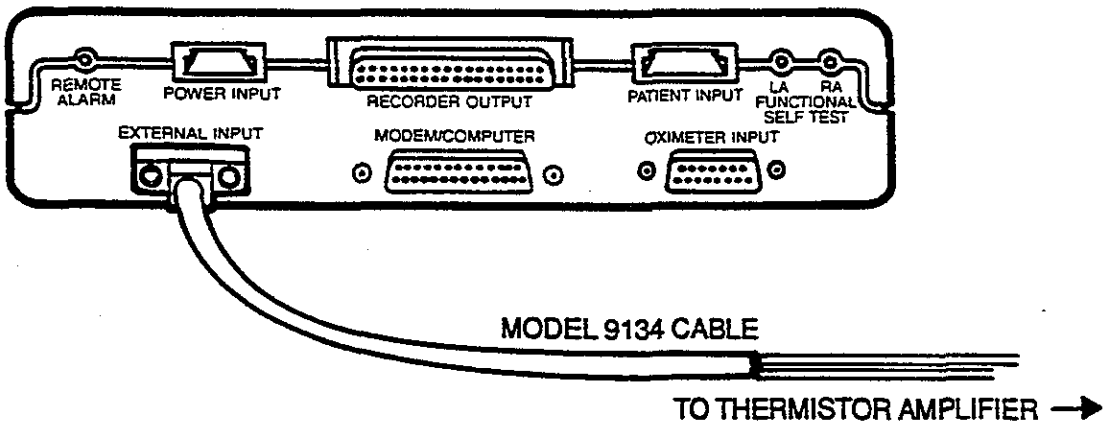
# X. USING OTHER EXTERNAL MONITORING DEVICES

Thermistor airflow, strain gauge, esophageal pH, and other data can be recorded by connecting external devices to the SmartMonitor. Follow the general directions listed below, and the detailed instructions provided with the external device(s).

**Step 1.** Place the external device on a flat surface and place the SmartMonitor near the device.

**Step 2.** Channels 3 and 4 of the SmartMonitor must be programmed to accept the data. Set Channel 3 Record to EXTERNAL, and/or Channel 4 Record to EXTERNAL.

**Step 3.** Connect a 9134 (mini phone plugs) or 9136 (user-specified connectors) cable from the output of the external device to the EXTERNAL INPUT connector (SmartMonitor back panel).



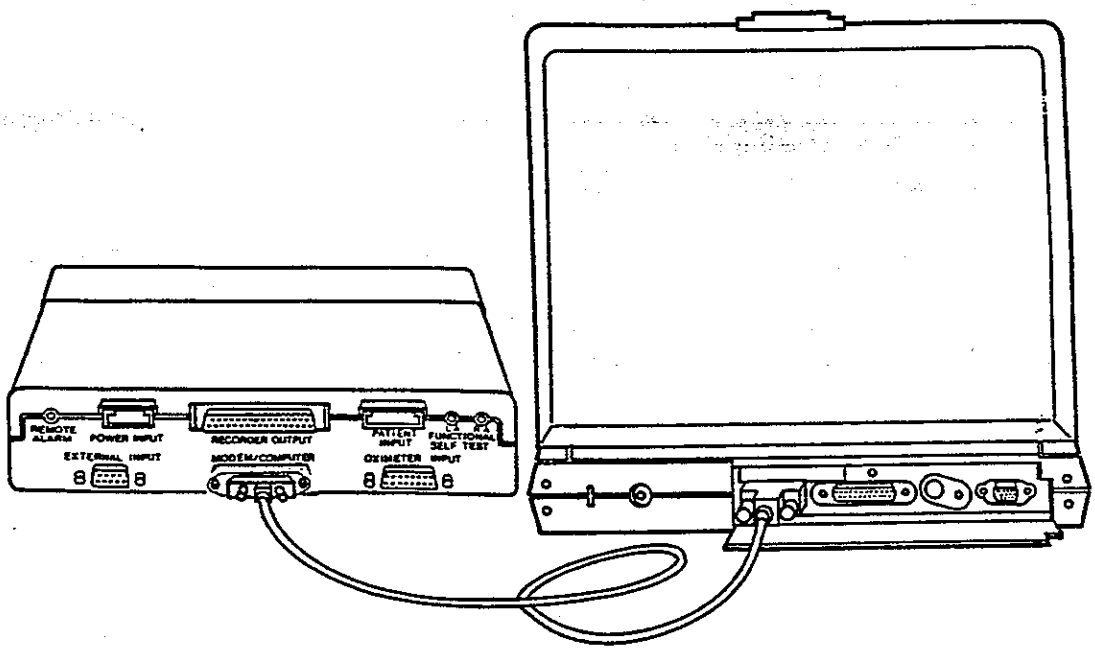

**NOTE:** Healthdyne will provide a cable for many external devices. Contact Product Support at (800) 421-8754 for assistance.

# XI. USING A COMPUTER WITH THE SMARTMONITOR

The SmartMonitor is designed to be used with Healthdyne 9500SE System Software and either a desktop or portable computer. If you are using a computer not supplied by Healthdyne, the specifications of the computer must match Healthdyne compatibility requirements. Call a Healthdyne Technical Support representative if you have questions on computer compatibility.

**For Healthdyne computers:**

(1) Connect a 9150 or 9151 Cable to the MODEM/COMPUTER connector of the SmartMonitor (back panel) and to the serial port of the computer. Refer to the computer User's Manual to locate the serial port. The cable connections must be securely made before the SmartMonitor is put into the Communications Mode.




(2) Set up the SmartMonitor in Communications Mode.

- Press and hold the blue ALARM RESET button.
- Press and release the POWER OFF/ON button.
- Wait until the Monitor alarms, release the ALARM RESET button, and then momentarily press and release the ALARM RESET button again.

If the FULL MEMORY light is on, press the ALARM RESET button to silence the alarm.

**NOTE:** When the SmartMonitor is in the Communications Mode, the bottom panel display reads "COMM MODE SELECTED." Always connect the 9150 or 9151 Cable **before** the SmartMonitor is placed in the Communications Mode.

Refer to the Series 9500 Computer Systems Operator's Manual for instructions on using the computer with the SmartMonitor.

# XII. USING THE MODEL 982 or 980 MEMORY MODULE

The Model 982/980 Memory Module is designed to transfer (to itself) SmartMonitor memory contents via the SmartMonitor MODEM/COMPUTER connector. Upon completion of a successful transfer (download), the Memory Module automatically erases the SmartMonitor memory. After downloading a SmartMonitor, the Memory Module can be connected to a computer and downloaded with 9500 software just as a SmartMonitor would be downloaded.

**Step 1.** Make sure the Memory Module and the SmartMonitor power is OFF.

**Step 2.** Connect the Memory Module directly to the MODEM/COMPUTER connector of the SmartMonitor (rear panel). Do not use a cable between the Memory Module and the SmartMonitor.

**Step 3.** Set up the SmartMonitor in the Communications Mode.

- Press and hold the blue ALARM RESET button.
- Press and release the POWER OFF/ON button.
- Wait until the Monitor alarms, release the ALARM RESET button, and then momentarily press and release the ALARM RESET button again.

If the FULL MEMORY light is on, press the ALARM RESET button to silence the alarm.

The SmartMonitor beeps every 10 seconds whenever the SmartMonitor is in the Communications Mode, but not electronically "connected" or linked to the Memory Module. This is a reminder that the SmartMonitor is powered on for working with the Memory Module, but not to monitor the infant.

**NOTE:** When the SmartMonitor is in the Communications Mode, the bottom panel display reads "COMM MODE SELECTED."

****WARNING****

**Don not connect the infant to the SmartMnitor if you prepared the SmartMonitor to work with the Memory Module in the Communications Mode (Step 3). The Apnea and Heart rate alarms do not work when the SmartMonitor is set up (in the Communications Mode) for use with the Memory Module.**

Refer to the Model 982/980 Memory Module *Professional Instructions for Use* for further details on using the Memory Module with the SmartMonitor.

**NOTE:** The 982 and 980 Memory Modules are compatible with all Type 02 and earlier SmartMonitors.

# XIII. CARE OF THE MONITOR AND ACCESSORIES

## The Monitor:

Use a clean cloth with a dishwashing detergent or 3% Hydrogen Peroxide solution (the type found in most stores) to clean the outside of the monitor. Never clean the monitor while the monitor is in use or the Battery Charger is plugged into an electrical outlet. **Never immerse the monitor in water.** Do not clean the monitor with (rubbing) alcohol.

### Fumigating a Roach/Insect-Infested Monitor

- Place the monitor inside a Zip-lock® plastic bag, ie.e. fruit/vegetable bag or large freezer bag.
- Insert a pest strip or Roach Motel® inside the bag with the monitor.
- Seal the bag tightly, and leave it at room temperature or warmer for a minimum of 30 days.

During the incubation period, any insect eggs inside the monitor will hatch. Consequently, the offspring will evacuate the monitor and be killed by the chemicals from the pesticide.

- After 30 days, remove the monitor from the bag. Dispose of the bag, and clean the monitor thoroughly according to the above instructions.
- After all insects have been killed, the monitor can be returned to Healthdyne Service for internal cleaning and recertification for the standard charges.

## The Electrodes:

The electrodes can be cleaned with a mild soap and water, but they must be rinsed well to remove any traces of soap film. Soap film can prevent heart and breathing signals from being picked up clearly from the monitor. **Disconnect the electrodes before cleaning.** Do not clean the electrodes with (rubbing) alcohol.

## The Electrode Belt:

The belt should be washed by hand and rinsed thoroughly. The belt should never be placed in the washer or dryer. This may cause the belt to shrink. Do not clean the electrode belt with (rubbing) alcohol.

## The Lead Wires:

Hand the lead wires carefully. **Never immerse them in water.** Do not clean the lead wires with (rubbing) alcohol.

## The Battery Charger:

**Never immerse the Battery Charger in water.** Always use a properly grounded three-pronged outlet. Always use an outlet not connected to a wall switch.

## The Remote Alarm:

The Remote Alarm can be cleaned in the same way as the Monitor. **Never immerse the Remote Alarm in water.** Do not clean the alarm with (rubbing) alcohol.

## The Soft Carrying Case:

Although the care label in the carrying case suggests machine washing in warm water, the appearance of the carrying case will change noticeably after washing. Healthdyne recommends that you wipe the case with a damp cloth or sponge using a light detergent, if necessary. Air dry only.

# XIV. MAINTENANCE AND SERVICE

## Simulator Test

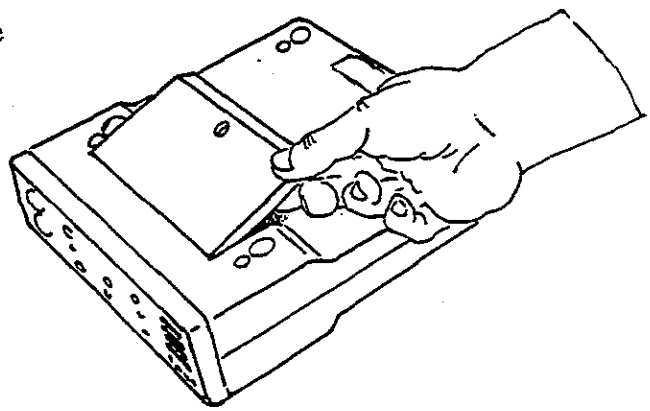
The SmartMonitor should be tested between patients or every 6-12 months, using the Healthdyne Model 5000 ECG/Respiration Simulator in accordance with the Model 925 *Checkout Procedure Manual.* Monitors which have been used in a home environment should always be tested between patients. Annual calibration/recertification by Healthdyne Service is optional, as long as the unit passess all requirements of the 925 *Checkout Procedure Manual.*

## Field Replacement of the Battery Pack

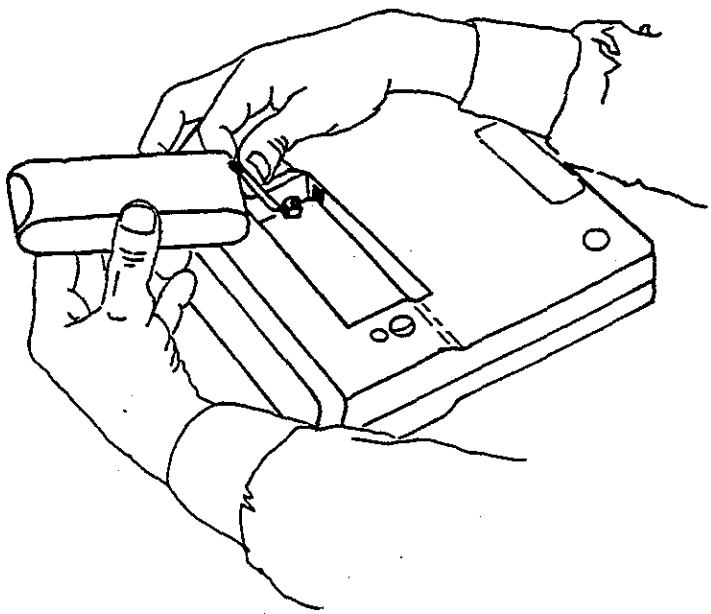
The NiCad battery pack will normally provide a useful life well beyond the warranty period, typically 2-3 years. If the battery pack should require field replacement, use the following procedure:

**Step 1.** Turn the SmartMonitor power off using the correct Power-Off procedure and unplug the Battery Charger from the SmartMonitor.

**Step 2.** Remove the screw from the battery pack cover and remove the cover.

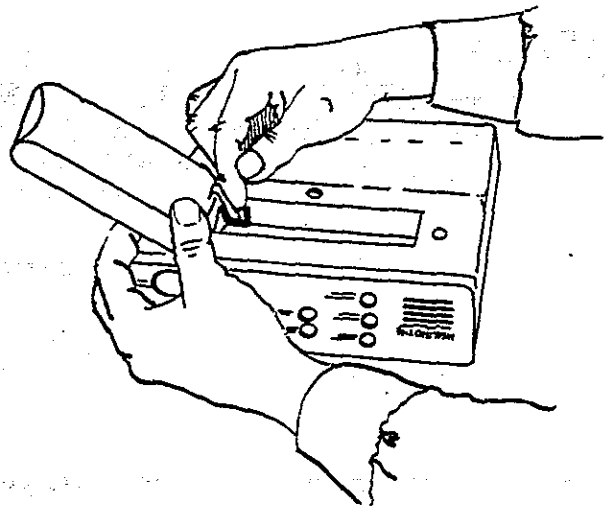


**Step 3.** Remove the old battery pack — pull the connector out gently. Dispose of the old battery pack in accordance with your area's environmental laws.

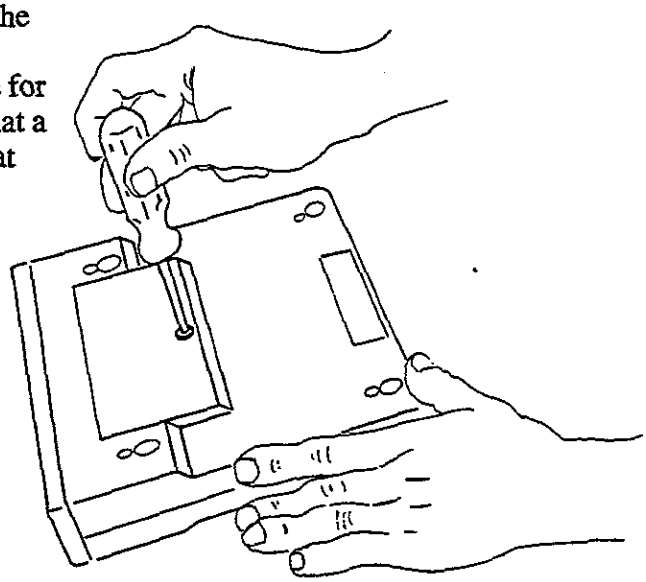


**NOTE:** This procedure will erase the SmartMonitor memory, and will result in an entry in the Equipment Events Log of the 900SL, 950S and 970S entitled, "System Initialized."

**Step 4.** Insert the connector of the new battery pack. It can only be inserted in one way. Place the battery pack in the battery compartment. Make sure that the wires lie vertically along the side of the battery pack, not under the battery pack.



**Step 5.** Close the battery pack cover and fasten with the screw. Connect the Battery Charger to the SmartMonitor and allow the battery to charge for at least 24 hours. Healthdyne recommends that a complete Functional Self-Test be performed at this time.



****WARNING****

**Never change the battery pack while the Battery Charger is plugged in and/or the SmartMonitor is being operated.**

Do not operate the SmartMonitor with the Battery pack removed, and with the Battery Charger connected. There is no power loss alarm feature under these conditions.

## Healthdyne Replacement of Internal Batteries

At least once every five years, the SmartMonitor should be returned to Healthdyne for replacement of the clock chip, which contains an internal battery. Beginning in 1995, Healthdyne-serviced monitors received replacement clock chips which have a useful life of 10 years.

If a weak internal clock chip battery causes a continuous audible alarm, and the bottom panel reads, "ERROR CODE 2," the memory may be cleared and the alarm and record parameters may be reset to standard values. Refer to the Troubleshooting Guide on page 61.

## Service

For Repair Service, contact a Healthdyne service representative at (800) 421-8754 or (404) 499-1212. A Technical Reference Manual is available after signing a Confidentiality/Non-Disclosure Agreement.

## Accessing the Rear Panel Connectors

**Recorder Output**

**Pin#/Description**

01 Charger Plus
02 Charger Minus
03 Charger Shield
04 GND
05 GND
06 GND
07 GND
08 GND
09 GND
10 QRS Detect
11 Resp Detect
12 GND
13 Oxford ECG
14 Oxford Reference
15 Oxford Respiration
16 Oxford Power
17 Oxford Alarm
18 GND
19 NC
20 NC
21 NC
22 NC
23 NC
24 NC
25 NC
26 NC
27
28 Trend/Event Alarm
29 Bradycardia Condition
30 GND
31 Linear ECG
32 GND
33 Linear Respiration
34 GND
35 AGC ECG
36 GND

**Oximeter Input**

**Pin#/Description**

01 +5V Power Supply
08 GND
10 Pulse Analog signal
11 SpO2 Analog signal

**Connector**
DB15M

**External Input**

**Pin#/Description**

01 Channel 3
External analog signal input
02 Channel 4
External analog signal input
05 Ground reference for
Channels 3 & 4
03 External Alarm 1 input
(waveforms recorded when active)
04 External Alarm 2 input
(no waveforms, Equipment Event Log entry only when active)
06 Ground reference for External Alarms 1 & 2

**Connector**
DB9M

**JAE-36 Male Connector Part Numbers**

PLUG: 192-0036-00
SHELL: 199-0036-00
PIN: 195-0036-00

# XV. WARNINGS AND CAUTIONS

- **Federal law restricts this device to sale by, or on the order of, a licensed physician. This instrument should be used only under the supervision of a physician.**

## The SmartMonitor - General Precautions

- The SmartMonitor is a monitor. It will not prevent or restore the interruption or loss of breathing and/or heart activity.

- Some apneas will be missed by apnea monitors. The monitors may mistake body movement for breathing, or if the baby has apnea due to choking (obstructions), the monitor could mistake movement caused by choking for breathing. The monitor will detect most apneas not caused by choking.

- Be aware that apnea monitors are not perfect. Most apnea monitors will miss some apneas (no breathing). For example, they may mistake body movement for breathing. Also, if the baby has apnea due to choking, the monitor could mistake the movement caused by choking for breathing.

- Encourage parents to use their Monitor. Parents should be certain to monitor the baby as prescribed. Although it is not perfect, the Monitor will detect most apneas not caused by choking. Most monitors will also warn you if the baby's heart rate becomes abnormal. But the Monitor can only do its job if it is turned on and properly connected to the baby. Advise parents not to stop using the Monitor without physician approval.

- Do not x-ray the SmartMonitor equipment (i.e., airport security checks). This may damage the internal electronic components.

- Do not sterilize the SmartMonitor.

- Report problems with the Monitor. If the Monitor isn't working properly, contact Healthdyne immediately for service and watch the baby closely while the Monitor is not working properly.

- Follow the manufacturer's recommendations. Be sure to read, understand and follow the instructions in the manual that comes with the apnea monitor. If you don't have a manual, contact Healthdyne Customer Service.

## The Monitoring Environment

- Be aware of signal interference which can occur from external sources. Electronic signals are required for the SmartMonitor to function. Sources of external interference could cause the monitor to miss apnea and heart rate alarms. Even though the monitor contains methods and techniques which can provide protection from external sources of interference, you should operate the monitor as follows:

    - Keep monitors at least three feet away from all electrical appliances. Some examples of this include TV sets, electric blankets, air conditioners, microwave ovens, and cordless and cellular telephones.

    - Synthetic fabric from draperies or rugs can also cause interference due to static electricity. Touching an inanimate object (wall, crib, etc.) before handling the patient or the SmartMonitor often prevents static build-up problems.

    - Strong transmitter signals from TV, radio, airport, police, fire and ambulance stations could be picked up as heart and/or breath signals. If located less than one mile from one or more of these sources, ask Healthdyne Technical Support to assist you in determining whether your monitor will operate properly.

    - Check the monitor's breath detection indicator. Listen while the baby breathes and watch the "breath" or "respiration" detection light on the monitor . While the baby is breathing quietly, the light should flash once and only once for each breath the baby takes, although it may flash additional times when the baby is moving. If the baby is breathing quietly and the "breath" or "respiration" light flashes more or fewer times than the baby breathes, contact Healthdyne Technical Support immediately. This can help determine if the monitor is affected by this type of interference.

- In some locations the monitor will not work properly. If the monitor is affected by external interference in the area, you may not be able to use the monitor.

- Advise the parents to keep children and pets away from the monitor. Children and pets could accidentally disconnect the monitor or cause other accidents. Advise the parents to be cautious — particularly when out of the room.

- Place the monitor on a sturdy and level surface. Do not place the monitor on the carpet or in the crib.

- If monitoring two or more infants in the same area, keep the monitors, patient cables and lead wires at least three feet apart. Close proximity of the monitors, patient cables or lead wires may cause missed apneas due to interference.

- Do not connect the infant to the SmartMonitor if the monitor was prepared to work with the Modem (placed in the Communications Mode). The Apnea and Heart alarms do not work when the SmartMonitor is set up with the Modem in this way.

- Do not send information via modem during electrical storms. Information could be lost or equipment could be damaged.

## The Monitoring Environment (continued)

- Do not place liquids on or near the SmartMonitor.
- Do not use the SmartMonitor in conjunction with other impedance monitors, including other SmartMonitors. This may cause missed apneas due to interference.
- The SmartMonitor is not intended for use with cardiac or diaphragmatic pacemaker patients.
- When using the monitor near oxygen-dependent patients, keep the monitor outside the oxygen tent, and at least three feet away from the tank (source) or other flammable gases.
- Do not advise parents to use rockers or to sleep with the monitored baby. Touching or moving near the baby, monitor, or cables could cause the monitor to miss apneas.
- Do not use a 60 Hz (hertz) Monitor/charger in a location with 50 Hz power. Do not use a 50 Hz Monitor/charger in a location with 60 Hz power. Look at the power rating on the serial number label to determine whether the Monitor is 50 Hz or 60 Hz. Most U.S. and Canadian power systems are 60 Hz.
- Do not use a 120V charger in a location with 220V power. Do not use a 220V charger in a location with 120 V power. Look at the power rating on the Battery Charger to determine whether it is 120V or 220V. Most U.S. and Canadian power systems are 120V.

## Alarms

- Respond immediately to all SmartMonitor alarms according to physician instructions.
- Advise parents to be tolerant of false alarms. False alarms cannot be completely avoided. Some of them are actual apneas where the monitor alarm has stimulated the baby to breathe again. Many false alarms may be caused by movement, loose lead wires or improperly placed electrodes.
- Be sure that the alarm is working. Be sure that the alarm works during the monitor self-test. Check the alarm before each use. If the alarm does not work, call Healthdyne Service immediately. Watch the baby closely until the problem is solved.
- Be sure that the alarm can be heard. Make sure the alarm can be heard from other rooms or while there is noise in the house. Have someone test the monitor alarm while you are in those rooms or noisy environments. If the alarm is not loud enough to be heard in the rooms where you need to hear it, provide a Model 990 Remote Alarm.
- Do not use your Monitor if the audible alarm sounds weak or does not activate upon initial Power-On or during the performance of the Functional Self-Test feature. Contact Healthdyne Service.

## Accessories

- Always keep the SmartMonitor and accessories out of the reach of children.
- Do not use non-safety style lead wire and patient cable configurations with this monitor. Using non-safety style lead wire and patient cable configurations may pose a risk of severe electrical shock or death. Refer to the operating instructions in this manual to assure that proper lead wire and patient cable connections occur. Use only Healthdyne safety lead wire and patient cable configurations.
- Remove the electrode belt and the lead wires when the patient is not being monitored.
- Do not plug electrode lead wires into electrical outlets. Lead wire contact with electrical outlets presents a serious shock hazard, and may cause injury or death.
- Handle the lead wires carefully to prevent them from breaking inside the insulation. Always grasp the lead wire at the strain relief area to remove them from the electrodes or patient cable.
- Do not allow the patient cable, lead wires, or Battery Charger cable to become tangled, coiled, or crossed, or wrapped around the patient's neck, arms or legs. This condition may cause strangulation.
- Do not clean the SmartMonitor while the Battery Charger is attached and connected to an electrical source. Do not immerse the SmartMonitor, Battery Charger, patient cable, or lead wires in water. Never use the monitor on a patient while the patient is being bathed. This could result in electrical shock and/or damage to the equipment.
- Check the battery or charger connection. **Gently** wiggle and twist the connectors to be sure they are tight. The CHARGING light should not flicker when the connectors are gently wiggled or twisted.
- Never use an extension cord with the Battery Charger. Always operate the Battery Charger using a properly grounded AC power outlet. Connecting a green wire on a three-prong to two-prong adapter to the receptacle cover screw does not usually provide a "grounded" connection. If unsure whether a power outlet(s) is properly grounded, contact an electrician for assistance.
- Disconnect the Battery Charger during lightning storms to reduce patient risk.

# XVI. TROUBLESHOOTING GUIDE

Whenever a technical problem occurs which you cannot handle, contact the dealer or Healthdyne. Do not attempt repairs to the SmartMonitor other than those described in this manual.

| PROBLEM | POSSIBLE CAUSE | INSTRUCTIONS |
|---|---|---|
| **Monitor will not operate.** | Monitor disconnected from Battery Charger, batteries discharged. | Plug Battery Charger into monitor and outlet. |
| | No power at outlet. | Locate an outlet with power. |
| | Defective Battery Charger. | Contact your dealer or Healthdyne. |
| | Defective batteries. | Replace battery pack (see pages 54-55). |
| | Internal part failure. | Contact your dealer or Healthdyne. |
| **Monitor will not operate. Display reads:** | | |
| Error Code 0 | Improper system start-up has occurred. | Contact your dealer or Healthdyne Service. |
| Error Code 1 | Invalid processor instruction detected. | Contact your dealer or Healthdyne Service. |
| Error Code 2 | Improper removal of system power, or weak internal clock chip battery. | Battery pack removed while power was on. Switch power off, then on to reset. Contact Healthdyne Service. |
| Error Code 3 | System parameter error detected. | Contact your dealer or Healthdyne Service. |
| Error Code 4 | Improper control of front panel LEDs. | Contact your dealer or Healthdyne Service. |
| Other Error Codes | Internal problem | Contact your dealer or Healthdyne Service. |

| PROBLEM | POSSIBLE CAUSE | INSTRUCTIONS |
|---|---|---|
| **Alarm Sound continuous.** | Incorrect Power-Off sequence. | First, turn the monitor power back ON. Next, press and hold the ALARM RESET button. Press and release POWER OFF/ON. Wait two seconds, then release the ALARM RESET button. |
| | No power, batteries discharged. | Connect Battery Charger. Use Power-Off procedure to silence alarm. Prior to use, allow batteries to charge 24 hours. |
| | Internal part failure. | Contact Healthdyne Service. |
| **LOOSE CONNECTION light remains on.** | Connections between electrodes, lead wires, and patient cable are not properly made. | Verify that (a) patient's skin underneath electrodes is clean, (b) electrodes are clean, and (c) lead wires are fully inserted into the electrodes and patient cable. |
| | Defective lead wires. | Replace lead wires and perform Functional Self-Test. |
| | Defective patient cable. | Replace patient cable and perform Functional Self-Test. |
| | Defective electrodes. | Replace electrodes. |
| | Internal part failure. | Contact Healthdyne Service. |
| **Alarm sounds weak.** | Internal part failure. | Contact Healthdyne Service. |
| **No access to Parameters Display Menu.** | Incorrect key sequence entered. | Power OFF (follow the proper sequence) and enter the sequence again. Be sure to fully press the buttons. |
| | | Call Healthdyne or your dealer for verification of correct sequence. |
| | Sequence not entered in allotted time. | Power-OFF (follow the proper sequence) and enter sequence again, within 10 seconds. |

| PROBLEM | POSSIBLE CAUSE | INSTRUCTIONS |
|---|---|---|
| **"System Initialized" appears in the Equipment Events Log. Alarm and Record Parameters changed to standard values. Memory erased.** | Battery Pack has been changed or temporarily disconnected. | Verify battery maintenance history. |
| | SmartMonitor was left on for long period of time, totally discharging the batteries. | Recharge batteries for 24 hours minimum. |
| | SmartMonitor was exposed to temperature of 41° F (5° C) or less, which is below minimum operating temperature. | Never leave SmartMonitors in vehicle during cold weather. If memory needs to be retained, don't expose SmartMonitor during shipment or storage to temperatures below 41° F (5° C). |
| | Internal error condition detected by SmartMonitor. | Reduce likelihood of electro-static discharge around Smart-Monitor. Contact Healthdyne Technical Support for assistance. |
| **While monitoring, constant audible alarm (without alarm lights). Pressing RESET will not silence audible alarm.** | Internal error condition detected by SmartMonitor. | Reduce likelihood of electro-static discharge around Smart-Monitor. Contact Healthdyne Technical Support for assistance. |
| **Upon Power-On, constant audible alarm (without alarm lights). Pressing RESET will not silence audible alarm.** | POWER button was not fully pressed, causing momentary power contact with subsequent "Power Off" (sibling) alarm. | Correct "Power-Off" alarm per instruction label. Always fully press POWER button when powering SmartMonitor on. |

# XVII. SPECIFICATIONS

| | |
|---|---|
| ***Input Signal Range*** | |
| ECG Sensitivity | 10 to 275 BPM, 0.5 mV; 10 to 150 BPM, 0.2 mV |
| Respiration Sensitivity | 4 to 150 BrPM @ 2 Ohms; 8 to 75 BrPM @ 0.5 Ohm; 30 BrPM @ 0.15 Ohm |
| ***Alarms*** | |
| Apnea | Delay settings of 10, 15, 20, 25, 30, 40 seconds |
| Low Breath Rate | Off, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 25, 30 BrPM |
| Bradycardia | 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 BPM<br>Optional delay of 5 seconds. |
| Tachycardia | Off, 90, 100, 110, 130, 150, 170, 190, 210, 230, 250, 270 BPM |
| Loose Connection | Base Impedance exceeds 2000 ± 200 Ohms |
| Low Battery | |
| Warning | Battery voltage low, Battery Charger required promptly |
| Shutdown | Battery voltage too low to continue w/o Battery Charger |
| Sibling | Power switched off w/o depressing Alarm Reset button |
| Full Memory | Memory is approximately 80% full, repeats when memory is 100% full |
| ***Memory System*** | |
| Capacity | 500 Patient event listings, 500 Equipment event listings |
| 970S waveform events* | 500 HR trend and respiration; or 50 ECG QRS, HR trend, and respiration; or 10 hours of continuous HR trend and respiration. Eighteen hours maximum with one continuous waveform (other than QRS) |
| 950S waveform capacity* | 25% of 970S capacity.<br>*Oximetry or other signals can be recorded with a reduction in capacity |
| ***Signal Channels*** | |
| Internal | QRS, heart rate trend, and respiration |
| Oximeter | Saturation and pulse, or pulse rate |
| External Input | Airflow, pH, strain gauge, or other physiological signals, ±2.5V maximum |
| ***Events*** | |
| Internal | Apnea Record, Apnea Alarm, Low Breath Rate, Bradycardia for Record, Bradycardia Alarm, Tachycardia Alarm |
| Oximeter | +3.5V to +5.0V during alarm condition |
| External Input | External Alarm 1, HIGH (+3.5 V) or LOW (0 V) during alarm condition (patient alarm records waveform)<br>External Alarm 2, HIGH (+3.5 V) or LOW (0 V) during alarm condition (equipment alarm, no waveforms recorded)<br>Body Positions of prone and non-prone |
| Event Duration | Alarm duration plus current pre- and post-settings totalling 45, 60, 90 seconds |
| Apnea Record | Off or 2 to 40 seconds in two-second intervals |
| ***Electrical*** | |
| Safety Tests | Meets CSA 22.2/No. 125, UL544 and AAMI/ANSI SCL Electrical Safety Standards |
| CSA Listing | CSA File #LR 50199 |
| Power Input | |
| SmartMonitor | 8.25 VDC |
| Battery Charger | 120 V, 60 Hz or 230 V, 50 Hz |
| Batteries | Rechargeable NiCad, 6 V, 1.8 ampere-hours, 24 hours continuous use; recharge time, 24 hours @ 77° F Shelf life, 30 days if fully charged |
| ***Physical*** | |
| Size | HWD: 2 3/32" x 8 1/2" x 9" (5.3 x 21.6 x 22.9 cm) |
| Weight | 3 lbs., 14 oz. (1.77 kg) maximum |
| Shipping Weight | Approximately 8 lbs., (3.66 kg) |

# XVIII. ACCESSORIES

**Part Number — Accessory Item**

| | |
|---|---|
| **700** | Digital Rate Display |
| **701** | Cable, SmartMonitor to 700 Display |
| **970VHS** | "*Monitoring Your Infant*" Parent Training Tape |
| **970VHS-S** | "*Monitoring Your Infant*" Parent Training Tape in Spanish |
| **901** | Soft Carrying Case |
| **908** | Patient Cable |
| **909** | Nurse Call Interface Assembly |
| **913** | Battery Charger (Power Supply) |
| **915** | Replacement NiCad Battery Pack |
| **922** | *Home Operator's Manual* for SmartMonitor, Includes 322-0084-00 Instruction Label |
| **923** | *Professional Operator's Manual* for SmartMonitor, Includes 322-0084-00 Instruction Label |
| **925** | Checkout Procedure Manual — SmartMonitor |
| **937** | CPR Posters, ten sets (3/set) Infant CPR, What To Do If Unable to Give Breaths, and How to Answer Alarms |
| **977** | Spanish Overlay Kit, Includes 577-0977-00 Instruction Sheet |
| **980A** | Adapter, 980/982 Memory Module to 9151/9150 Computer Cable |
| **980** | Memory Module, for all SmartMonitors (except 970SE) |
| **982** | Memory Module, for all SmartMonitors |
| **990/25** | Remote Alarm, battery powered, w/ 25 ft. cable |
| **990/100** | Remote Alarm, battery powered, w/ 100 ft. cable |
| **990-25** | Cable, 25 ft. SmartMonitor to 990 Remote Alarm |
| **990-100** | Cable, 100 ft. SmartMonitor to 990 Remote Alarm |
| **2400V** | Modem, 2400 V.42bis |
| **5000** | ECG/Respiration Simulator |
| **6122** | Cable, SmartMonitor/930 Oximeter to 6100 Data Recorder (records ECG QRS) |
| **6123** | Cable, SmartMonitor/930 Oximeter to 6100 Data Recorder (records heart rate trend) |
| **6124** | Cable, SmartMonitor/Nellcor/Ohmeda Oximeter to 6100 Data Recorder (records QRS/respiration) |
| **6125** | Cable, SmartMonitor/Nellcor/Ohmeda Oximeter to 6100 Data Recorder (records heart rate and trend/respiration) |
| **6200** | Thermistor Amplifier |
| **6205N** | Preemie Thermistor Airflow Sensor (nasal only) |
| **6205-1** | Double-sided tape for 6205 Thermistor (25 each) |
| **6210** | Infant Thermistor Airflow Sensor (nasal/oral) |
| **6210N** | Infant Thermistor Airflow Sensor (nasal only) |
| **6210-1** | Double-sided tape for 6210 Thermistor (25 each) |
| **6220** | Thermistor Airflow Sensor, Infant/Pediatric (nasal/oral) |
| **6220-1** | Double-sided tape for 6220 Thermistor (25 each) |
| **6230** | Thermistor Airflow Sensor, Adult (nasal/oral) |
| **6230-1** | Double-sided tape for 6230 Thermistor (25 each) |
| **6240** | Large Adult Thermistor Airflow Sensor (nasal/oral) |
| **6240-1** | Double-sided tape for 6240 Thermistor (25 each) |
| **6255** | Extension cable 10 ft., Thermistor Amplifier or pH SmartMeter to Recorder Cable |
| **6260** | Velcro® Mounting Kit (attaches 700 Display/6200 Thermistor Amplifier to SmartMonitor) |
| **9108** | Pocket Screwdriver |

**Part Number — Accessory Item**

| | |
|---|---|
| **9130** | Cable, SmartMonitor "Oximeter Input" to 930 Oximeter, with waveform event triggering |
| **9130N** | Cable, SmartMonitor "Oximeter Input" to 930 Oximeter, without waveform event triggering |
| **9132** | Cable, SmartMonitor "Oximeter Input" to Nellcor/Ohmeda Oximeter, without waveform event triggering |
| **9134** | Cable, SmartMonitor to "External Input" to external devices (mini phone plugs for ch 3 & ch 4) |
| **9136** | Cable, SmartMonitor to "External Input" to external devices (no connectors) Waveform triggering possible with some external devices. |
| **9140** | Cable, SmartMonitor to 975 Modem |
| **9141** | Cable, SmartMonitor to 2400V and 9600V Modems |
| **9150** | Cable, SmartMonitor to 25-pin Computer |
| **9151** | Cable, SmartMonitor to 9-pin Computer |
| **9155** | Cable, Modem to Phone Jack, 7' |
| **9160** | Cable, Modem to Phone Jack, 25' |
| **9175** | Body Position Sensor, includes 577-9175-00 *Parental Instructions for Use* |
| **9175-2** | Cable, SmartMonitor to 9175 Body Position Sensor, for 2-position data; includes 577-9175-20 *Professional Instructions for Use* |
| **9175-2E** | Cable, SmartMonitor to 9175 Body Position Sensor, and external devices (Ch 3 and Ch 4), for 2-position data; includes 577-9175-20 *Professional Instructions for Use* |
| **9185-1** | Safety Lead Wires, Clip-to-Socket, 24" (1 bag = 5 sets) |
| **9510** | Electrodes, neonatal, hydrogel with pre-attached safety lead wires, .080"socket (5 sets, 3 electrodes/set) |
| **9515** | Electrodes, pediatric, hydrogel with pre-attached safety lead wires, .080" socket (5 sets, 3 electrodes/set) |
| **9520-1** | Safety Lead Wires, Pin-to-Socket, 24" (1 bag = 5 sets) |
| **9521-1** | Safety Lead Wires, Pin-to-Socket, 40" (1 bag = 5 pair) |
| **9555** | Cable, SmartMonitor to Memory Module (optional extension) |
| **9916** | Set-up Accessory Kit, Includes: 2 pink/blue Electrode belts, 2 pairs of reusable electrodes, and 2 pairs of pin-to-socket lead wires |
| **9916-12** | Replacement Kit, Includes: 12 pink/blue Electrode belts, 12 pairs of reusable electrodes, and 12 pairs of pin-to-socket lead wires |
| **16510-1** | Reusable Electrodes for Velcro belt (5 pair) |
| **16530-1** | Reversible (pink/blue) Electrode belts (1 bag = 10 each) |
| **16936** | *Parents' Guide to Infant Monitoring*, English (Generic, covers all Healthdyne monitors except Model 16000) |
| **16936-07** | *Parents' Guide to Infant Monitoring*, Spanish |
| **199-0023-00** | Adapter, mini phone plug to sub-mini phone plug. Enables use of Ohmeda oximeter cables with Nellcor oximeter. For use with 6124, 6125, 9132, and 9134 cable. |
| **260-0412-00** | Rubber shroud for older style 913 Battery Charger "ears" |
| **260-0413-00** | Rubber shroud for older style 908 Patient Cable "ears" |
| **322-0084-00** | Instruction Label, removeable, for SmartMonitor |
| **500-0140-00** | Replacement Rubber Foot for SmartMonitor |
| **260-0950-20** | Replacement Bottom Panel LCD Menu Cover for SmartMonitor (with window) |
| **322-0229-00** | Accessory (patient cable/lead wire) warning label for all Healthdyne apnea monitors |

# XIX. LIMITED WARRANTY

Healthdyne warrants each new instrument to be free from defects in material and workmanship for a period of one year from the date of purchase by the end-user, except that ancillary items used with the instrument are so warranted for a period of 90 days from the aforesaid date. Disposable items are not covered under this warranty.

If any such defect in an instrument or ancillary item occurs during the warranty period, Healthdyne at its option will repair or replace the defective instrument, ancillary item, or part(s).

For purposes of this limited warranty, "instrument" is defined as a stand-alone device capable of performing specific functions. "Ancillary items" are products which may be required for the instrument to perform one or more functions. "Disposable items" and "expendable items" are, respectively single or limited-use products normally required for normal use of this instrument. The term "end-user" is defined as a hospital or, when concerning instruments or ancillary items used on a rental service, the rental dealer.

THIS LIMITED WARRANTY IS IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, PROVIDED, HOWEVER, THAT IMPLIED WARRANTIES ARE NOT DISCLAIMED DURING THAT PERIOD OF THIS LIMITED WARRANTY.
NOTE: SOME STATES DO NOT ALLOW LIMITATIONS ON THE DURATIONS OF AN IMPLIED WARRANTY; THEREFORE, THE PRECEDING LIMITATION MAY NOT APPLY TO YOU.

Healthdyne shall have no obligations or liabilities in connection with the instrument or ancillary items other than is provided herein, including without limitation any and all obligations and/or liabilities for alleged negligence, or for strict liability; furthermore, in no event shall Healthdyne be liable for incidental or consequential damages, either direct or contingent.

NOTE: Some states do not allow the exclusion or limitation of incidental or consequential damages; therefore, the preceding exclusion or limitation may not apply to you. This Limited Warranty gives you specific legal rights; you may also have other rights, which vary from state to state.

This Limited Warranty shall be void and shall not apply:

(a) if the instrument or ancillary item has not been installed and connected in accordance with the instructions provided by Healthdyne;
(b) if the manufacturer's seal is broken, or if there is other evidence of access to the instrument's or ancillary item's electronics;
(c) if the serial number has been altered, effaced or removed and you do not have a bill of sale or evidence to verify the product's purchase date; or
(d) to defects arising from misuse, negligence or accidents, or from repair, adjustment, modification or replacement made outside Healthdyne's factories or by anyone other than an authorized Healthdyne dealer or service agent.

Replacements and/or repairs furnished under this Limited Warranty do not carry a new warranty, but carry only the unexpired portion of the original Limited Warranty.

The cost associated with the returning of instruments and/or ancillary items to Healthdyne authorized service centers for warranty service are not included in this Limited Warranty.

The terms of this Limited Warranty may not be varied by any person, whether or not purporting to represent or act on behalf of Healthdyne.

To obtain service under this Limited Warranty, you must promptly notify Healthdyne of the nature of the problem and the serial number or date of purchase of the product. If Healthdyne determines that repair is required under this Limited Warranty, the defective instrument, ancillary items and/or part(s) must be returned to Healthdyne's factory or designated Healthdyne authorized service center. Item(s) must be properly packaged, insured, and shipped to Healthdyne postage/freight prepaid.

HEALTHDYNE TECHNOLOGIES

# RESPONDING TO ALARMS - Parental Instructions

**If An Alarm Sounds, You Should:**

**I. Check your child's skin color immediately.**
If your child looks pale, dusky, or blue, start physical stimulation immediately. Respond as instructed by your doctor in your CPR class.

**II. If your child's skin color is normal, check to see if he/she is breathing.**

If your child is not breathing, respond as instructed by your doctor or in your CPR class. An example of your response could be as follows:

(1) Gently pat the baby. The baby may correct the cause of the alarm on his/her own.
(2) If the baby does not correct the cause of the alarm, start physical stimulation immediately. Respond as instructed by your doctor or CPR class.
(3) If the baby does correct the alarm, note it on your log sheet.
(4) Press the ALARM RESET button to reset any alarm lights.

If your child is breathing, respond as instructed by your doctor or in your CPR class. An example of your response could be as follows.

(1) Wait for a few seconds. Watch to see if the baby's breathing and color remain normal.
(2) Check the SmartMonitor to see which light is on. Note it on your log sheet.
(3) If the alarm sound is continuous, look at the following:

**A. The LOOSE CONNECTION Light**
If this red light is on, check the connections between the electrodes, lead wires, patient cable, and the monitor. If something has come loose, reconnect it and press the ALARM RESET button. The alarm should stop. If the alarm does not stop, turn off the SmartMonitor. Then check the following items:

**The electrodes** -- They should be clean and there should not be any cracks on the surface.
**The baby's skin** -- Make sure that where the electrodes are placed is clean and free from oil, lotions, or perspiration.
**The electrode belt** -- Make sure it is snug and keeping the electrodes in the proper place.

**B. The LOW BATTERY Light**
If this red light is flashing every 30 seconds, plug in the Battery Charger immediately. The yellow CHARGING light will come on. The LOW BATTERY light will stop flashing when the Battery Charger has been plugged in long enough to partially recharge the batteries. Fully drained batteries need about 24 hours to recharge.

**C. No lights at all are on**
The SmartMonitor was turned off without pushing the ALARM RESET button first. Press the POWER OFF/ON button to turn the monitor back on. Power-off correctly.

HEALTHDYNE TECHNOLOGIES

# SMARTMONITOR® PRESCRIPTION

**Patient** _____

**Phone** _____

**Date** _____

**Model** ❑ 970S ❑ 950S ❑ 900SL ❑ 900S

**Modem** ❑ 9600VO/9600V* ❑ 2400V* ❑ 975(1200)

**Oximeter** ❑ 930 with 9130N (non-triggering cable)
❑ 930 with 9130 (triggering cable)

| **Alarm Parameters** | **Settings (circle one)** |
|---|---|
| Apnea Delay (sec) | 10 15 **20** 25 30 40 |
| Low Breath Rate (BrPM) | **Off** 4 5 6 7 8 9 10 12 14 16 18 20 25 30 |
| Bradycardia (BPM) | 10 20 30 40 50 60 70 **80** 90 100 |
| Bradycardia Delay (sec) | **0** 5 |
| Tachycardia (BPM) | Off 90 100 110 130 150 170 190 210 230 250 270 |

| **Recording Parameters** | **Settings (circle one)** | |
|---|---|---|
| Record Mode | **Event** Continuous Event Log Off | |
| Pre/Post Time (sec) | **30/15** 45/15 60/15 75/15 15/30* 30/30* 60/30 45/45 30/60 15/75 | |
| Respiration | **On** Off | |
| Apnea Delay (sec) (for recording only) | Off 2 4 6 8 10 12 14 **16** 18 20 22 24 26 28 30 32 34 36 38 40 | |
| Heart Rate Trend | **On** Off | |
| ECG QRS | **On** Off | |
| Channel 3 | **Off** Pulse External | |
| Channel 4 | **Off** $SpO_2$ External | |
| External Alarm 1 | **Off** High Low | These are for research purposes only, and therefore normally set to OFF. |
| External Alarm 2 | **Off** High Low | |

* Available on Type 02 units only.

**BOLD** = "Standard Values" for 970S, Type 02 units.

_____, MD Phone (  )_____

NOTES: _____

_____

_____

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HEALTHDYNE TECHNOLOGIES

# Infant Monitor Event Log

| Date | Time - a.m./p.m. | No. of Beeps Heard | What You Found: Baby: Awake | Asleep | Breathing | Not Breathing | Skin Color: (B)lue, (R)ed, (P)ale | Apnea | Monitor Alarm: Low Heart | High Heart | Loose Connection | Nothing - Baby Was Breathing | Nothing - Baby Self-Started | What You Did: Hand On Back | Gently Stimulated | Stimulated Vigorously | Mouth to Mouth CPR | How Long Had Baby Been Asleep? | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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